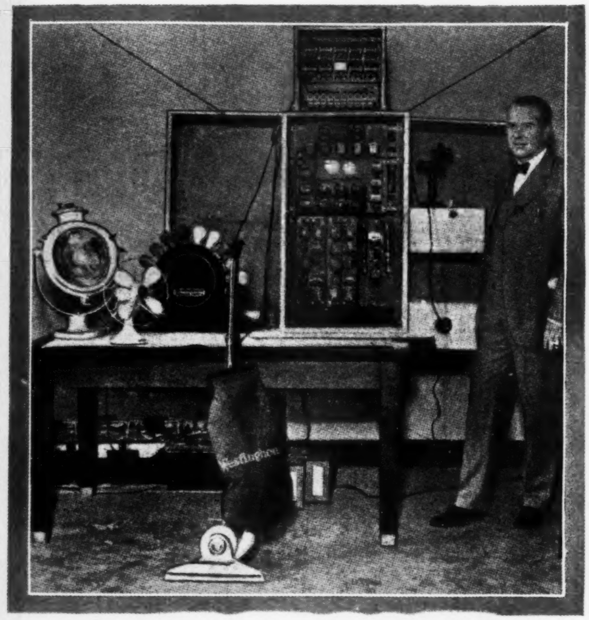
CHRISTMAS NUMBER

DISCOVERY

A Monthly Popular Journal of Knowledge

Vol. VIII. No. 96. DECEMBER, 1927. PRICE 1s. NET



THE AUTOMATIC SERVANT AND ITS INVENTOR.
(see page 380)

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NOTE.—***The publishers have acquired the goodwill and connexions of* Modern Science *and* Conquest.**

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Editorial Notes.

CHRISTMAS is of all seasons the most agreeable to book-lovers, and in publishing our Christmas number we include this year an unusual study of present-day literature. Whether or not the modern scientific outlook is jeopardising much that to many of us makes Christmas what it is, cannot as yet be judged; in suggesting that the rising generation be encouraged to discover for itself the delights of Hans Andersen, not to mention of Dickens, our contributor reveals some interesting tendencies. In the realm of children's books others not less worthy are taking the place of the former favourites, but it is not so certain among the older readers that the adventures of Pickwick or the charms of "The Christmas Carol" are as widely enjoyed as hitherto. Certainly to name the successors of these classics is a fascinating problem, yet we hope that for many winters to come they will continue to be read round every fireside.

* * * * *

When the new food preservative law was first introduced, we commented on the immediate fillip that was given to the manufacture of refrigerators. The various machines now on the market are described on another page this month, the article pointing out that from 1st January next many new foodstuffs will be affected by the regulations. The development of other artificial means for preservation now has a parallel in a discovery reported from America, where fruit is being ripened chemically. While it is illegal to dye green fruit, it appears that exposure to ethylene gas hastens ripening not only in appearance but in the properties accompanying it. Thus the sugar content of bananas has been increased, and similar changes also occur in vegetables, such as celery. Mr. R. B. Harvey is working on this process at the University of Minnesota, but the mechanism is not yet fully understood; probably the ethylene affects the respiratory rate of the fruit or vegetable. The discovery followed the observation that when carnations fade they give up a gas that consists largely of ethylene.

* * * * *

What appears to represent a new race of Arabian gazelle was announced at a meeting of the London Zoological Society, when Captain Dollman exhibited a mounted head from the Duke of York's collection. He proposes to name this new island race *Gazella arabica hanishi*, after the locality where it is found, Great Hanish Island in the Red Sea, and it differs from the typical *arabica* form in various colour respects. Two black spots on the forehead at the base of the horns extend down the face almost to the nasal marking, which itself is much larger and more sharply defined. The upper parts of the animal are considerably less rufous and the dark flank stripe seems to be more developed, in this last respect approaching one of the two mainland forms from north of Aden. The typical *arabica* race came from the Farsan Islands, some two hundred miles north of the new locality.

* * * * *

The confused impression left by some of the ecclesiastical statements about science in the newspapers recently, was considerably cleared by Dean Inge in the Norman Lockyer lecture on 21st November. "The man of science, the philosopher, and the religious genius," said the Dean, "are all alike creative artists, interpreting to us the values of the world of knowledge and experience. One of the most wonderful discoveries of astrophysics is that the whole universe, including ourselves, is all of one piece, woven on the same loom. It is constructed of the same elements, and obeys the same laws, which it is the glory of the human mind to discover. Each new scientific discovery, especially in the domain of astronomy, exalts human nature in humbling it. It gives fresh proof of the amazing power of the mind to extend its survey to the furthest confines of space, and the

remotest period of time. Each new discovery opens new avenues of thought, adds new splendours to kindle the imagination, and assuredly imposes upon us new responsibilities. If we believe in God, we may be sure that no revelation is made merely to gratify idle curiosity; if we are agnostics, we probably arrive at the same conclusion by a different road."

* * * * *

Some edicts of the Emperor Augustus discovered at Cyrene have now been described to the Society for the Promotion of Roman Studies as by far the most important discovery of the kind made recently. The marble slab containing these inscriptions was found during Italian excavations some years ago, but their significance had not hitherto been discussed in this country. Four of the five edicts are of special interest as dealing with the senatorial province of Cyrenaica; they are dated 7-6 B.C., and throw light on the position of Augustus in relation to provinces which were not under his direct administration. In announcing these details, however, Professor J. G. Anderson offered them only as a provisional interpretation, and other new facts may be revealed by further study.

* * * * *

From time to time we have commented on the difficulty of keeping pace in reporting the results of research, which often remain the knowledge of specialists long after a discovery has been made. A typical case has arisen since we published in October an article on the treatment of infection, which in the course of discussing modern medicine stated that the first effect of "all known" antiseptics was to destroy the body's defences. Owing to pressure of space the article had been in type for some while before it appeared, and in the meantime an antiseptic was put on the market for which the hitherto missing property is claimed. "Monsol," as the new material is called, was actually discovered fifteen years ago, but not until it had been the subject of prolonged study was it made available to the public during the past summer. In February last the opinion of the medical profession was invited privately on a large scale, and as a result the claims have now been abundantly confirmed in practice. The proprietors of Monsol are further to be congratulated on refusing to allow its classification as a "patent" medicine.

* * * * *

Writing from Iraq, to which he has now returned to resume work at Ur, Mr. Leonard Woolley pays remarkable tribute in *The Times* to the influence of an Arabian sheikh who guarded the site during the past summer. Readers of the article contributed to *Discovery* by Mr. Woolley's archaeological assistant, Mr. Mallowan, will remember that work had to be abandoned in the spring just when success was at its greatest, the culminating find being a gold dagger dating from 3000 B.C. For obvious reasons the further fact could not then be published, that the excavation of the richest grave of all had to be left unfinished. "The discoveries had caused much excitement locally," Mr. Woolley writes; "the Arabs are desperately poor and here was treasure to be had almost for the asking. . . . Ur is a lonely place and the Arabs are a lawless people." Now that further digging has been carried out, it becomes clear how well a plunderer during the summer would have been awarded. Rich objects in profusion continue to come to light, and the finest new object as yet discovered is a large gold tassel, elaborately decorated.

* * * * *

Further details have just reached this country of the electrical device invented in America, which works in response to sound. We stated last month that at a demonstration by the Westinghouse Co. the machine obeyed spoken instructions, but it is now disclosed that operation by the human voice is only possible on an experimental scale. The controlling principle of the new mechanism lies in its sensitivity to sounds of different pitch, and the New York *Evening Post* reports that it is set in motion by sound waves of 1,400 cycles frequency and stopped by 600 cycles frequency. Whistles of the exact pitch may be used to give the signals, though in practice electrically-vibrated tuning forks are apparently employed. We reproduce on page 390 a photograph of the new device, which is shown connected to an electric carpet-sweeper. It is hoped to develop its domestic applications, so that the housewife out shopping may turn on her oven or stove by instructions over the telephone!

* * * * *

Last month the International Radio Conference met at Washington, and in connexion with it the International Union of Scientific Radio Telegraphy held its regular meeting that takes place once in three years. The aims of the international union are to promote the scientific study of radio communication; to aid research work requiring international co-operation, with publication of results; and to facilitate agreement upon common methods of measurement. To correlate the work of the several national sections, in practice there are four international commissions on measurement and standards; wave transmission phenomena; atmospheric disturbances; and liaisons. The president of the union is General Ferrie, of France, while England is represented among the officers by Dr. W. H. Eccles.

Hunting in the Abyssinian Lakes.

By J. Omer Cooper, M.A.

An expedition of unusual scientific interest involved also exciting adventures with natives, whom the author encountered while accompanying Dr. Hugh Scott into the highlands of Abyssinia. One of the lakes visited feeds the Blue Nile, on which the proposed dam is arousing such controversy in the newspapers.

ABYSSINIA is a high mountainous tableland, almost entirely surrounded by low-lying desert, and is hence a vast temperate island in the midst of tropical desert. To study the fauna from the standpoint of its isolation was therefore one of the main objects of our recent expedition.

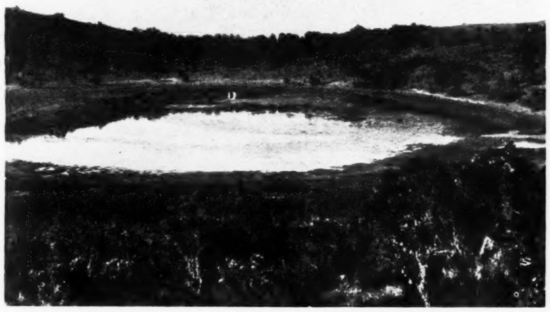


FIG. 1.
CRATER LAKE ON MOUNT ZAQUALA.
This is one of the finest examples in the world of a recent lake isolated by desert country, but work on its unusual fauna was interrupted by priests who believe its waters to be sacred.

Dr. Hugh Scott applied himself to the study of the land fauna, particularly the Insecta, his chief objective being the fauna of the ancient forest of the Abyssinian highlands. Dr. Scott is perhaps the first authority living on the fauna of old forests of the northern hemisphere, and he wished to compare the Abyssinian fauna with those of similar forests in other parts of the world. This work is, of course, of great economic importance, besides being of high value to students of distribution and oecology. Amongst other matters he made a special study of the fauna of the Candelabra tree, *Euphorbia* (Fig. 4), for comparison with corresponding fauna in south-west Morocco and the Atlantic Islands. Abyssinia is known to contain an insect population partly derived from the Orient and partly of Northern origin, besides true African forms and a fairly large proportion which are peculiar to the country itself. The Oriental and Northern forms must have made their way across wide deserts, this presenting one of the most interesting problems of animal migration. Another question is how far tropical forms which have migrated into temperate regions have become modified by their new environment and whether they show a tendency to take up the characteristics of species which normally inhabit temperate regions.

My own researches were almost entirely connected with the lake and pond fauna. In the previous year I had made an expedition to southern Tunisia to obtain specimens of a most remarkable crustacean *Thermesbaena mirabilis*, Monod, which had recently been discovered there and of which only a few specimens had been available for study in Paris and none in this country. It was hoped that in Abyssinia other strange forms might be preserved in those unexplored lakes which have been isolated since their formation and which have probably never had any connexion with the sea. This hope was not fulfilled, the Abyssinian lakes being found quite devoid of higher crustacea, but as they form part of a great chain of lakes which runs right down Africa, it was of great interest to investigate their fauna for comparison with those of Lake Tanganyika, etc. Until this expedition only the fishes and a few aquatic insects had been collected. The effects of altitude and climate, besides isolation, were other problems to be studied, and the lake on the top of Mt. Zaquala (Fig. 1) was therefore the main object of my journey. It is one of the finest examples in the world of a recent temperate lake isolated by desert country, and its fauna must necessarily be of exceptional interest, not only from the evolutionary standpoint but also from that of distribution.

As Dr. Hugh Scott is writing a book on his travels and the natural history of the Abyssinian forests and grass-lands, the following account will be confined to my own part in the expedition.

On arrival at Djibonti in the Gulf of Aden, we had to remain for three days as there are only two trains a week on the Abyssinian railway. Djibonti is one of the most burnt-up places imaginable; it is not an oasis, but just a town in the middle of a desert. The temperature in summer does not drop much below 100° F. even at night, and as the air is moist it is unpleasant, though it appears to be quite a healthy spot. We left at 6.30 a.m. by the Abyssinian

train, and for the first five hours travelled through a very hot stony desert, practically uninhabited, though we saw a few Somali with their little dark-coloured camels, which are not much larger than mules. The frontier was passed at 11 a.m. The Somali desert, with its black stones and dark-reddish sand, is perhaps the most desolate and terrible country in the world. After mid-day the scene improved, and we saw a few gazelle and antelope; towards evening we came to a country with many Acacia trees and quantities of Aloes, which were then in full flower and made the place look very beautiful.

We spent the night at Dire Dawa, and fortunately had no difficulty with the customs, as His Highness Ras Tafari had sent us a letter through the British Legation exempting all our goods from customs duties. Two days later we reached Addis Abeba, the terminus of the railway, about 4 o'clock. Although the journey was long, it was not uncomfortable, and the Abyssinian railway, considering all things, compares not unfavourably with some of our English lines. There are several reasonably good hotels in Addis Abeba, and we stayed there for a fortnight, collecting our caravan with the aid of a very able old native named Milko.

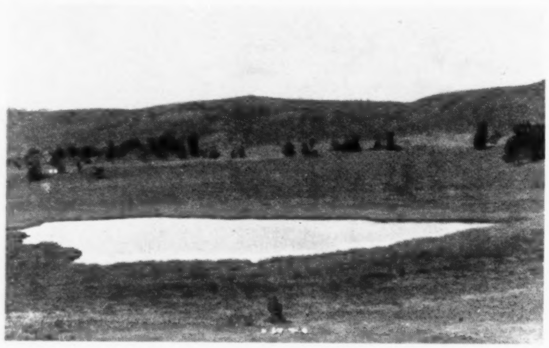


FIG. 2.
THE "SERPENT LAKE" AT WOURAMBOULCHI.
Every effort was made by the natives to prevent the author investigating this lake, which was believed to be the haunt of a man-eating serpent. The object in the foreground is a shrine built for sacrifices to the serpent, and some natives dressed in white are seen seated round it.

We were told that we should find it impossible to get the men to travel in the rains, but with Milko's assistance we succeeded in getting away quite easily, and after five days' treck through pouring rain and indescribable mud we reached our first goal, the Forest of Djem-Djem. Our camp was on the side of the mountain at about 8,100 feet, with the forest rising behind us to 9,000 feet; it was one of the most beautiful spots I have ever seen, the view from our tent across the great plain of the Hawash being magnificent. Here we remained for some time, collecting the forest fauna and investigating one or two small ponds which, as they are only full during the rains, contain a rather meagre fauna of Cladocera, Ostracoda, and a few aquatic insects. A fine large species of Rhabdocoel was found in the largest pond, and also a few specimens of the common Hydra, an amazingly widely-distributed animal which seems capable of adapting itself to a wide range of temperatures. From Djem-Djem I went to Wouramboulchi, a small village in the high country to the west, leaving Dr. Scott to continue his entomological investigations in the forest.

Here there is an interesting lake (Fig. 2) from which a stream rises that flows into the Blue Nile. The natives believe this lake to be inhabited by a great serpent, and this caused some little trouble. My head man tried to dissuade me from attempting to reach the lake on the following grounds. It was very deep, deeper than the Mediterranean and the Red Sea; it was inhabited by a great serpent which ate everyone who went out to the lake; and no one had ever been to the lake before. The lake was surrounded by a wide marsh with water about waist deep, and had a broad floating edge. When this edge was reached, progress was easy for some little distance, and at one place the marsh was not very extensive. Our fire-wood was carried out on to the floating edge, where a raft rather like a short ladder was constructed, and with this I hoped to reach the open water; the first attempt was not successful, as it sank with me, and no more wood suitable for the purpose was obtainable. The next day, however, six long bamboos were procured which, resting on the weeds, formed rails over which I managed to drag the raft, with the assistance of Abbagarou, a Mahometan Abyssinian who was the bravest of my men.

Four times my men struck, and then a large number of armed Gallas arrived in the camp to try to dissuade me, but by that time my temper was so short that they soon left the camp again. When I was on my way to the lake between forty and fifty of them gathered in my camp and shouted in unison. My boy told me that they were praying for my safety, as they were afraid of the consequences should I be devoured by their serpent. Both my own men and the local Galla tribes did all in their power to prevent my getting to the lake, but when I succeeded, they were much pleased. I fear I have destroyed a local deity, for sacrifices of sheep and oxen were made regularly to the great serpent. A sacrifice was offered the day after I arrived, but having been soaked to the skin

that morning trying to reach the lake, and the sacrifice being on the opposite side of the lake, to my great disappointment I could not attend the ceremony. The photograph of the lake (Fig. 2) was taken from the spot on which the sacrifices were made, and the small object in the foreground is a shrine built for the serpent, round which some Gallas are seated with some of my men. After I had reached the lake, and the serpent had taken no action, the natives began to feel doubtful of its existence, and several of them affirmed that they would no longer sacrifice their cattle to it.

The upland country round Wouramboulchi is the chief horse-breeding district of central Abyssinia, and is mostly open grassland with a few small woods of large cyprus trees. The fauna of the lake was similar in general species to that of the same type of pond in England, and many of the plants growing in or near it were similar or identical with plants found in grassy fields in the British Isles. The scenery here and in the neighbourhood of Addis Abeba is almost exactly like that of North Wales. After making careful collections from the lake I returned to Djem-Djem, and later we set out for Mt. Zaquala; going via Addis Abeba, we were delayed a few days there owing to the effects of drinking the very bad water at Akaki, the last camp before Addis Abeba is reached. Fortunately, by this time the rains were practically over, and travelling became much more pleasant.

Mt. Zaquala is a fine extinct volcano rising to 9,600 feet at its highest point, and in the centre of the crater is a small lake. Unfortunately our funds were extremely limited and did not allow us to afford a boat, so we were unable to investigate the lake as well as we could have wished. Clear water, was, however, reached by wading, and a series of tow nettings were obtained, as well as a good deal of the insect life round the edge; so that the greater part of the fauna was sampled. Their examination has yet to be completed, but there can be no doubt that it will yield results of great scientific value. As I have said the lake is exceedingly isolated—in reality, a great dew pond which is always cold, and surrounded by a wide semi-desert plain of tropical warmth.

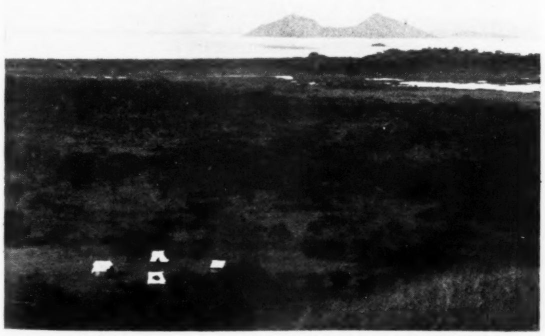


Fig. 3.
THE AUTHOR'S CAMP NEAR LAKE ZWAI.
To reach the lake it was necessary to travel through a mile of swamp. The island seen in the distance is the largest penal settlement in Abyssinia.

Fig. 4.
LAKE ZWAI SEEN FROM THE SOUTH.
The remarkable tree in the foreground is the Candelabra. During the expedition, Dr. Scott made a special study of its fauna.

Unfortunately only a few hours' work was possible, as after the second collection was made the Christian priests forbade us to approach the water again. This lake is sacred, as an archangel deposited in it some of Our Lord's blood and the mountain is, in fact, a mighty chalice. So holy is this water that neither man nor beast may drink it, and no camp may be pitched within the crater rim. Despite the cold and the fact that one of our men had pneumonia, we were forced to camp on the rim, and spent a very cold and rather difficult week there investigating the fauna of the mountain-top while our man recovered from his sickness. The whole mountain is dotted over with the homes of anchorites and small villages of priests and holy women, there being five churches and several schools there. Priests living on Mt. Zaquala must abstain from flesh, milk and butter during eleven out of the twelve months; as they do not eat fish their diet is very meagre indeed, and they are exceedingly punctilious in keeping their fasts.

From Zaquala we went to Lakkedamba on the west shore of Lake Zwai (Fig. 4), but were almost devoured by mosquitoes, so we decided to make our way to Mt. Chilalu, the forest and mountain fauna

of which Dr. Scott was anxious to investigate. There I left him and returned to Zwai, a fine fresh water lake with numerous islands. By the side of the Suc-Suci, a channel joining Lake Zwai to the alkaline Lake Hora Abjata, live two Germans, Dr. Zahn and Herr Goetz, with whom I stayed for four days while I collected in the lake. They very kindly lent me an indescribably delapidated canvas canoe, and in this I was able to make two expeditions on to the lake and obtain satisfactory tow nettings. The only way of reaching the lake was to travel up the Suc-Suci, as there is about a mile of swamp in many places and except at one or two points always a wide belt of weed between the open water and the shore. Hippopotami are said to be abundant, but I saw none ; fortunately these lakes do not contain any crocodiles. The fauna is not extensive and consists chiefly of small Copepoda. From a curious tree which grows floating in the swamp the natives make rafts, that are used as ferry-boats. I crossed the Suc-Suci (Fig. 5) on one of these, and though it was quite small and heavily loaded with cases piled high upon it, I was not wetted ; the wood is as light as cork and the raft merely consists of boughs tied together.

Warlike Natives.

This country is inhabited chiefly by pagan Arrusi Galla, a warlike race who grow no crops but live entirely on milk and meat. I did not see a single sick or feeble person while I was here, nor during the time I spent further south. Food is difficult to obtain, for the Arrusi have few needs and no desire for money, so that they cannot be induced to sell their food, or will only part with it for a high price. Further south I saw great herds of cattle but could not procure any milk at all, for the natives refused to sell their food. The Arrusi not only boil their clothes in butter, but they also cover their heads with it. The approach of Arrusi can usually be detected at a considerable distance by the smell, and they are always surrounded by a cloud of flies. An Arrusi does not marry until his head has been buttered, and as this ceremony may not be carried out until he has killed a man, a lion or an elephant, one cannot go out alone ; Abyssinians always travel in parties, heavily armed, and even then with considerable trepidation. Lions and elephants are practically extinct in the Arrusi country, so that as most of the men of mature years have buttered heads, a good many people annually must lose their lives in the neighbourhood.

From Lake Zwai I went on to the alkaline lake already mentioned, known as Hora Abjata, " Hora " being a native word meaning salt lake. Many lakes which are potable, but have a slight saltish flavour, are known by this name. The water of Hora Abjata is distinctly alkaline, and comparison of its fauna with those of Lake Zwai, to which it is joined by the Suc-Suci, will probably yield interesting information. The boat was used again here, and a good many tow-nettings were taken, which are now undergoing examination by specialists. This lake is remarkable for the number of birds which frequent it. I saw some thousands of flamingo, besides great flocks of egret ducks and ibis, and there were also numbers of stilts, pelicans, cormorants, gulls, darters, storks, marabou osprey, and grebe. It was a magnificent sight. Hippopotami were not uncommon, and when tow-nettings were being made near the mouth of the Suc-Suci a number swam about not far from the canoe and roared in an unpleasant manner. Although the salt water of this lake has killed all the trees which it has reached during overflows and seems to support only a single species of rush, there is a large insect fauna ; frogs are abundant in the marshes, while in the lake itself there live a good many small fish. I could find no evidence that these lakes are drying up, as has been stated to be the case by recent travellers, and the dead trees in the neighbourhood of Hora Abjata indicate that comparatively recently the lake has reached a higher level than it had done for many years previously.

A Mutiny.

When I wished to pass on to the Lake Hora Shala (Fig. 6), which was reputed to be very alkaline, I was strongly opposed by my men. The Nagadi (mule owner) said the mules were unfit for such a long and difficult journey, as it was a three days' treck through waterless desert. My head man said that the road was infested with brigands and that the Arrusi would certainly rob us and probably kill us. The soldier sent by the War Minister, Fiterary Apta Georgis, said that the region was outside his master's country and he could not accompany me—a statement that was untrue, but which may have been a mistake on his part.

Two days were lost in argument, and I had to resort to threats backed by a Mauser pistol before I could get away ; even then I only succeeded in leaving with three pack mules, three Zabanias (guards), my cook, groom, personal boy, and an Arrusi guide, and with only a small native tent. Very little apparatus could be carried, but we brought the canoe, which was one mule load. The journey proved to be only one long day's trek, and though the natives appeared

rather hostile they did not molest us. Abbagarou, my most faithful Zabania, fell ill on the way and never properly recovered. I do not know what was the matter with him, but I fancy it was tubercular pneumonia, and I got him back to hospital. After I left he was discharged, but was soon readmitted, and he died a month or two after I returned to England.

The lake was very alkaline indeed and impossible to drink, even for the mules, but fortunately the guide took us to some small hot springs where the water though unpleasant was drinkable. No vegetation grew in this lake, and it did not contain any insect life except the larvae of Chironomid midges and a species of bug nearly allied to *Naucoris*. The plankton was very thin and consisted principally of Rotifers and microscopic algae. Curiously enough there were fish in the lake, and I obtained a single specimen which proved to be a widely-distributed African species. It is a mystery how any animal could live in the water, which was a soda bath so strong that greasy clothing gave a lather when washed in it. To have reached such a spot without being able to make any proper investigation was very distressing, but in the circumstances I was fortunate to be able to get good samples of the plankton and had to be content with that. To investigate a lake such as this is a privilege few men have had, and to return there properly equipped and with sufficient time to make accurate observations is one of my greatest ambitions, for the lake offers so many problems of the greatest interest.

While I was there one of my men mistook a party of

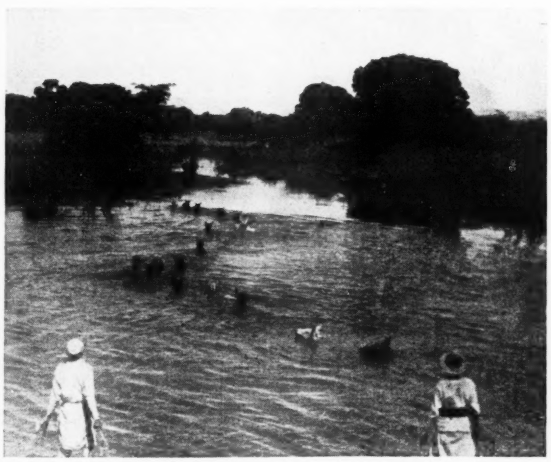


Fig. 5.
MULES CROSSING THE SUC-SUCI.
The pack animals are here swimming the Suc-Suci channel, near Lake Zwai while the baggage and personnel were carried on native rafts.

Fig. 6.
THE SALT LAKE HORO SHALA.
To reach this lake a day's trek through waterless desert was necessary, and the author had eventually to resort to the pistol in order to proceed there with part of his caravan, as the waters of the lake are undrinkable.

Arrusi for brigands and fired at them at about twenty yards with a service rifle, but fortunately missed them, and I reached him before he could fire a second shot. Had he hit one of them our chance of getting back would have been small, for they are a fighting people and our force was insignificant.

From Hora Shala I trecked straight back to Addas, only halting for one day at the Hawash river because the mules were too tired to go further without a rest. I sent Abbagarou back to Addis Abeba, and then spent a few days collecting in a very interesting series of small crater lakes at an elevation of about 7,000 feet. Here I met with an exciting experience. One evening, alone and unarmed, I was kneeling at my net when I heard a rustle and saw a hyaena watching me not three yards away. I jumped up, but it did not run, so I stepped forward and shouted and it backed slowly away. Hyaenas are usually cowardly, but have terrible jaws, so I was thankful to see the last of this intruder.

I was joined again by Dr. Scott, who had climbed Mt. Chilalu, 13,000 feet, and had travelled round it obtaining some very valuable material on the way. On completing the survey of these small lakes we returned to Addis Abeba, and I made my way back to England as my funds were exhausted. Dr. Hugh Scott, however, remained for some weeks longer and visited several other important localities, obtaining a magnificent collection of great scientific value.

The expedition was assisted by grants from the Royal Society and the Percy Sladen Trust, and made possible by the gratiousness of His Imperial Highness Ras Tafari and the help of the British Legation at Addis Abeba. We also owe much to the kindness of Mr. McLane (the British Consul), Mr. Charles Rey, Mr. Gardiner, and others, to all of whom I offer sincere thanks.

Christmas and Literature.

By H. A. J. Wilder.

A review of modern tendencies suggests that where literature is concerned "we cannot pretend that Christmas stands where it did." On the other hand, the problem remains how far the time-honoured books give a historic picture of the season.

CHRISTMAS, of course, has never been quite what it was. However severe the weather, somebody's grandfather is sure to remember a season which was harder still, when hounds were confined to kennels longer, and when hospitality was more abundant. And many of us will be tempted to let the old gentleman have his way. For, looking down from the cynical peak of middle-age and bearing in mind the record of recent years, it does sometimes almost seem as though we are never to see that old-fashioned Christmas again—as if the tinsel snow on the postcard and the frost-bound stories of our youth were after all only meant to flatter delusion in the old or foster illusion in the very young.

Pictures from Pepys.

The scientists no doubt have an excellent reason for it all. They can explain why it is that no one has ever skated up the Thames from Windsor to Maidenhead since 1894; why roasting an ox whole upon the village pond has become a legendary feat; and why no party of Oxford undergraduates is allowed an opportunity nowadays of driving a four-in-hand across the frozen Cher. But whatever their explanation, whether it has some mysterious connexion with the Gulf Stream, or whether, as has been ingeniously suggested, our modern milder conditions are Nature's revenge for a too intimate acquaintance with atmospherics on the part of the "ordinary listener," Christmas would seem to be losing each year something of the hardy reputation it had. How, for example, did Pepys find it in the years of the Great Diary—1660-1669? Quite according to standard if we may judge from a couple of extracts. Here is his entry for Christmas Day, 1662:—

"Up pretty early, leaving my wife not well in bed, and with my boy walked, *it being a most brave cold and dry frosty morning*, and had a pleasant walk to White Hall where I intended to have received the Communion with the family, but I came a little too late.

Four years later, in 1666, he writes (Christmas Day):—

"Lay pretty long in bed and then rose, leaving my wife desirous to sleep, having sat up till four this morning seeing her mayds make the mince-pies. I to Church, where our parson Mills made a good sermon. Then home and dined well on some good ribbs of beef roasted and mince-pies; only my wife, brother, and Barker (the maid) and plenty of good wine of my owne, and my heart full of true joy and thanks to God Almighty for the goodness of my condition this day. Then out and walked alone on foot to the Temple, *it being a fine frost*.

We shall be foolish, however, if we take any change there may seem to be too seriously. For the trouble lies deeper than either the Gulf Stream or the machinations of the B.B.C. The fact is, Christmas, as far as the weather is concerned, has been handicapped from the start.

Is there not, to begin with, the gravest uncertainty about the date itself? December is the height of the rainy season in Judaea. Under the circumstances shepherds are hardly likely to have been sitting watching their flocks by night in the open fields of Bethlehem, as late as the 25th. Yet, we read, as early as the fifth century, in spite of the strong claims of October, and probably in order that it might prove a counter-attraction to the heathern feast of *Saturnalia*, it was definitely decided that 25th December it must be. When the story of the Nativity reached northern climes, frost and snow naturally became the proper environment to the manger scene, and it is to the accompaniment of frost and snow that Christmas has been celebrated in prose and verse ever since.

A Future Problem.

And this brings us to an interesting reflection. How far is the great mass of Christmas literature responsible for the Christmas spirit? If, as we become more and more materialistic, it is less and less able to play its part, how far will the Christmas of the future be affected? For we cannot pretend that where reading is concerned, Christmas stands where it did. How can it; when instead of being the culminating point in a country house visit of six weeks it is becoming little more than a crowded incident in a week-end? Except surreptitiously in bed where is there time for Christmas reading now? Instead of the hours spent with some favourite author under a shaded lamp in our host's library and before an open fire—we shall be lucky if we find our host boasts a library, or an open fire at all. Even then some false bookcase may harbour a loud-speaker! To the true believer in "Christmas

atmosphere " these are all disconcerting thoughts. For to him, " Good King Wenceslaus," however perfectly sung by the Westminster Choir on the gramophone, can never replace the honest discords once produced by the " waits " at his back door ; nor will any pantomine, however funny, relayed from 2LO give half as much evening's enjoyment as the re-reading, for example, of Mr. Winkle's discomfiture before the fair Arabella on the ice.

With regard to carols, it is perhaps inevitable that, in the old-fashioned sense, they should have more or less had their day, and sung as they often are under modern conditions it is perhaps as well. When carol singers now have their own motor-cars, and singing outside the houses of complete strangers in the glare of their own headlights take several villages in their stride in a single night, most of the illusion, or at any rate, the intimacy of old-time carol singing is gone. Nor is the offering of a suitable reward so easy or spontaneous a matter. Yet carol singing is the earliest form of Christmas literature, and for Christmas diehards it will be a sad day when " No-el " is no more.

MR. WINKLE TUMBLES ON THE ICE.
From the etching by Phiz in the original edition.

With Dickens, however, it is different. Here in his own environment the enthusiast may still pick and choose. Let us return to Mr. Winkle who, blue with cold, has by this time managed to screw on his skates hind to fore.

" Now then, Sir," said Sam in an encouraging tone ; " off vith you and show em how to do it."

" Stop, Sam, stop," said Mr. Winkle trembling violently, and clutching hold of Sam's arm with the grasp of a drowning man. " How slippery it is."

" Not an uncommon thing upon ice, Sir," replied Mr. Weller. " Hold up, Sir."

" These—these—are very awkward skates ; ain't they Sam ? " inquired Mr. Winkle, staggering.

" I'm afeerd there's a orkard gen'l'm'n in 'em, Sir," replied Sam.

" Now Winkle," cried Mr. Pickwick, quite unconscious that there was anything the matter. " Come, the ladies are all anxiety."

" Yes, yes," replied Mr. Winkle with a ghastly smile, " I'm coming."

Even if he knows by heart every word of what follows, how the very prospect of it makes the reader wriggle in his chair !

Or where will the next generation find general expectancy and the traditional atmosphere painted with more certain strokes than in the glimpse we are giving of Mr. Pickwick being called on Christmas morning.

" Well, Sam," said Mr. Pickwick as that favoured servitor entered his bed-chamber with his warm water on the morning of Christmas Day, " still frosty ? "

" Water in the wash-hand basin's a mask o'ice, Sir," responded Sam.

" Severe weather, Sam," observed Mr. Pickwick.

" Fine time for them as is well wropped up, as the Polar Bear said to himself ven he was practising his skating," replied Mr. Weller.

" I shall be down in a quarter of an hour, Sam," said Mr. Pickwick, untying his night-cap.

" Werry good, Sir," replied Sam.

And cannot we picture the jovial old fellow the moment Sam had shut the door, overflowing with kindly feelings and animal spirits, rushing to the window to see what the day is really like ? Assuredly if they do not occasionally accept Mr. Wardle's invitation to spend Christmas at Dingley Dell our children will be missing a great deal.

But we must not be too pessimistic. Christmas is essentially for the young, and some of us are prudent enough not to stray far from the nursery all our lives.

" We believed in highways then
And could glimpse at night
On Christmas Eve
Imminent oncomings of radiant revel—
Doings of delight ;
Now we have no such sight."

writes the octogenarian author of " Yuletide in a Younger World." But for most of us the appropriateness of the last line lies entirely in our own hands. We must remember too, that the favourites of one age are displaced by the favourites of another almost

without our realizing that it is we who are getting old. Thus, the whole Gollywog Series including "The Gollywog's Christmas," popular among children twenty years ago, is succeeded to-day by "When We Were Very Young," "Now We Are Six" and "Winnie-the-Pooh." Charlotte M. Yonge and Mrs. Molesworth were highly thought of before "Christopher Robin" was born. Our parents thrived on Hans Andersen and Grimm. Similarly, coming on to the grown-up level, and, if we do not press comparisons too closely, Robert Louis Stevenson, Matthew Arnold, George Gissing, and Alexander Smith have been succeeded by Thomas Hardy, Lawrence Binyon, Alfred Noyes, T. S. Eliot, G. K. Chesterton, and Siegfried Sassoon.

To-day and To-morrow.

As long as we live amongst them we cannot tell who of the Christmas writers to-day will be the favourites of to-morrow, but we should be wrong to assume that they do not exist. Of one thing we may be certain. However well they write, they will not receive the deference accorded to the giants of old. Deference of any kind is not in fashion to-day; it will be less in fashion than ever in the future. Never again will a crowd, thrilled by an English author, gather on the quayside at New York and wait for its monthly news of Little Nell. Cinema rights and Signor Marconi have seen to that. And if we revert once again to the present day we shall have to admit this further disturbing thought. It is not only the books which refer directly to Christmas which are involved. There are the old friends which we have been accustomed to keep for these long winter evenings year after year. How will Dr. "Monty" James make our flesh creep satisfactorily in the future with his inimitable ghost stories without the flickering concomitant of fire-light upon wall and ceiling? What gas-fire yet invented can supply this need? How shall we be properly thrilled by the swing of Poe's pendulum if all the time we are maddened by modern syncopation from next door, or how travel once again with old Umslopogaas to "King Solomon's Mines" if the telephone be buzzing in our ears?

Yet shocking as all this may seem the spirit of Christmas need not necessarily suffer thereby. Modern ingenuity has probably something else other than literature already in store. It is only we, with our eye too fondly glued to the printed page, who are too short-sighted to see it. Gone after all are all the ceremonies attached to the Yule log, the Lord of Mirsule, as it was termed, and his Scottish prototype, the Abbot of Unreason. Yet they were considered important enough in their day. Is it not only natural that our established favourites should go too? Hardly however, can the most despondent of us conceive of them as being forgotten. Handel and Bach among the musicians, Wesley, Heber and Keble among the hymnologists, Milton and Tennyson among the poets, Dickens, Jane Austen and Thackeray among the novelists—these names will surely be "household words" as long as roast beef and plum pudding endure? And most of all, of course, Dickens.

Let us, at the risk of being thought hopelessly sentimental, turn off just for a moment the loud-speaker, so that we may hear the Chimes; turn on whatever modern imitation of an open hearth we may find installed; stretch our feet out before its artificial blaze, and opening "A Christmas Carol" once again renew acquaintance with Scrooge, Bob Cratchit and Tiny Tim.

"'A merry Christmas, Bob!' said Scrooge, with an earnestness that could not be mistaken, as he clapped him on the back. 'A merrier Christmas, Bob, my good fellow, than I have given you for many a year! I'll raise your salary, and endeavour to assist your struggling family, and we will discuss your affairs this very afternoon, over a Christmas bowl of smoking bishop, Bob! Make up the fires and buy another coal-scuttle before you dot another i, Bob Cratchit!'

"Scrooge was better than his word. He did it all, and infinitely more; and to Tiny Tim, who did NOT die, he was a second father. He became as good a friend, as good as master, and as good a man as the good old City knew, or any other good old city, town, or borough in the good old world. Some people laughed to see the alteration in him, but he let them laugh, and little heeded them; for he was wise enough to know that nothing ever happened on this globe, for good, at which some people did not have their fill of laughter in the outset; and knowing that such as these would be blind anyway, he thought it quite as well that they should wrinkle up their eyes in grins as have the malady in less attractive form. His own heart laughed, and that was quite enough for him.

"He had no further intercourse with Spirits, but lived upon the Total-Abstinence Principle ever afterwards; and it was always said of him that he knew how to keep Christmas well, if any man alive possessed the knowledge. May that be truly said of us, and all of us! And so, as Tiny Tim observed, God bless us, Every One!"

A Voyage of Discovery.

Here it would seem to us better than in all your Charleston and Jazz, as well as in any other of your modern distractions is the spirit of Christmas conveyed. And it is hard to see how our children will get on without it. If, therefore, in years to come, at the risk of reproof, we can persuade one of them to pause in his headlong flight to take down at Christmas time one of our well-worn favourites from the shelf and explore, will it not be our duty to do so? We shall be starting him on a voyage of Discovery indeed.

A Very Unladylike Ladybird.

By O. A. Merritt-Hawkes, M.Sc., and T. F. Marriner, F.E.S.

The distinctive habits of ladybirds have hitherto, as far as known, dissociated them from the beetle family to which they belong. The authors have now discovered the life-history of a ladybird which tells quite another story and throws new light on these insects.

In 1758 the great Swedish naturalist Linnaeus described a new ladybird which he named *Coccinella II-punctata*. During the hundred and seventy years that have since gone by, many entomologists have collected and studied this insect for the remarkable variations of the black spots which adorn its bright red wing cases. Special names have been given to some seventy of the commonest spot variations known, but until a few months ago the details of its life-history had never been discovered.

LARVA OF THE ELEVEN-SPOT LADYBIRD
Unlike other ladybirds, this type spends its early life in a dung pad, where it passes through several stages of development. (Block lent by the Entomological Society).

Coccinella II-punctata, the Eleven-spot ladybird, is clearly a relative of the Two-spot* and of the Seven-spot, so well known now as the friends of the horticulturist, but because of its somewhat long and flat appearance it looks more like a beetle than either of these common ladybirds. It is found all over Europe from Iceland southwards, but occurs in largest numbers on flat meadows behind coast sand dunes and on fertile alluvial flats such as those around the Solway Firth and other estuaries. At times it is also seen in great numbers on the large salt marshes of Lorraine.

We think of a ladybird as a bright, scrupulously clean little insect, and up to the present it has been regarded as an insect whose whole life from egg to adult is passed in pleasant surroundings, bright sunshine, and fresh air. Man decided that ladybirds lived among plants and ate green fly and sometimes parts of leaves. When an idea becomes fixed it is difficult to accept opposing and new ideas, so in trying to discover the secret of the Eleven-spot life-history no one dreamed of looking for it in such unladybirdlike surroundings as a pad of cow dung or horse droppings. Scientists knew, of course, that ladybirds were beetles but they were in a group apart from many beetles, in that it was believed that they always breathed fresh air, hunted for their food like sportsmen, and preferred light to darkness.

The authors have now discovered that there is at least one exception and that the Eleven-spot spends part of its life, just like many another beetle, in the warm moist darkness of a pad of dung, where it does not hunt for living food but eats the semi-decayed food prepared for it by bacteria and moulds. It does not, however, spend all its life in this medium, but combines in one life-history the habits of a dung beetle and the habits and characteristics of all the other ladybirds at present known.

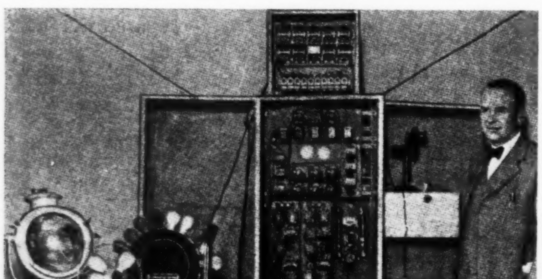
Sometime during May when the weather is fine and warm the eleven-spot ladybirds leave their winter quarters among the grass roots and come out into the sunshine. Mating takes place and the female when fertilized is at once attracted to a dung pad, but not to any pad for it must not be too damp or too dry, too warm or too cold, and there must be hole, in its surface leading into passages wide enough to admit her with ease. This ladybird is well supplied with olfactory organs which guide her, like a female fly, to a suitable spot for oviposition. She walks for a short distance down one of the passages—made either by the escape of gases generated within the fresh dung pad, or by escaping insects when it is older, but certainly not made by the ladybird herself—

* See "Researches on the Two-Spot Ladybird." T. F. Marriner, *Discovery*, December, 1926.

and carefully chooses a position for her eggs. The pad is very full of life, and up and down these passages by day and night pass many insects, so the ladybird usually suspends her eggs from the roof of the passage. There they hang, the base of each embedded in the manure, in batches of from 5 to 23 eggs, until, at the end of four to five days the shell breaks and the colourless larvae push out their heads and front legs.

At the end of five or six hours emergence is complete and the new-born larva has taken on an almost black colour. Unlike some of their open-air relatives these larvae make no attempt to eat each other, but almost immediately set to work upon the abundant food which is under, above, and around them. After about two days comes the end of the first stage or "instar." Now comes a brief rest while the skin is cast, and then feeding is resumed. After four more days a second change of skin follows and the larva is much bigger. During this early period of its life the larva differs much in its behaviour from the larvae which spend their life on roses, fruit bushes, and other plants. The latter are used to bright lights, sudden movements, and shadows, but the dung born larvae are very sensitive and if disturbed by even a shadow at once curl up their rather long legs and appear as if dead.

By the end of the third instar this sensitiveness is not so marked and when the fourth and last instar is reached the larva has changed not only in size and



[*Photo from "Literary Digest," New York.*

THE AUTOMATIC SERVANT AND ITS INVENTOR.

As described in the Editorial Notes on page 380, this new American device, invented by Mr. R. J. Wensley, works in response to vocal instructions.

colour but also in nature. It is now much larger, of a deep black colour with a bluish bloom upon it, and its light tubercles have become a dull orange colour. During this last instar it leaves the darkness of the dung pad and wanders over the outside surface and on to the neighbouring grass blades where it probably feeds upon greenfly. Then it pupates, sometimes on the surface of the pad, sometimes just inside one of the passages. This stage lasts a week, and then the imago emerges, twenty-six to thirty-two days after the time its mother laid the egg from which it hatched. The newly-emerged insect is very conspicuous with its soft, spotless, bright yellow elytra or wing cases, but before many hours have passed its black spots have developed, and the bright yellow colour has become a brilliant light red.

A Taste for Salt.

Then the ladybird flies off to eat and to mate. Those born in June or July mate and die; their progeny, born in August, after completing their instars and emerging as imagos, feed a while and then go into winter quarters to emerge again in the following spring. The perfect insects will, in captivity, eat various kinds of greenfly: probably in nature their chief food consists of those found upon marram grass, and on the other grasses of the flats where the ladybirds occur. Apparently the presence of salt is necessary, for, so far as is known, the Eleven-spot is only found in numbers on pastures near the sea, and on salt marshes, where it breeds in the dung droppings of cattle fed upon the grasses grown there. Attempts to breed the Eleven-spot in the dung of cattle fed on cake or on inland pastures where salt is absent from the air have so far failed, whereas experiments with dung brought from salt marshes have succeeded.

The Eleven-spot has enemies. A parasitic dipterous fly (*Phalacrotophora fasciata Fln.*) lays its eggs in the body of the larva, and when these hatch out the parasite kills the larva by feeding upon it. A dung beetle (*Aphodius punctato-sulcatus*) has also been observed to kill, but not to eat, both a larva and an adult Eleven-spot. An unknown fungus found in the dung is also fatal to the larvae, and the black-headed gull picks out many of these insects as well as others from the dung. The wing cases of the Eleven-spot have been found in the gull droppings, with those of two other species of ladybird found near coasts.

This totally unexpected life-history of the Eleven-spot brings the ladybirds into line with the great family of Coleoptera to which they belong and in which, up to the present, they have occupied an anomalous, isolated, and incomprehensible position.

Radioactive Haloes: Their Cause and Interpretation.

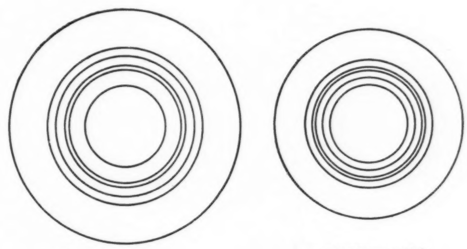
By A. S. Russell, M.A., D.Sc.

Haloes are "hieroglyphics" characteristic of radioactive elements, but three new kinds discovered recently cannot so far be ascribed to any known element. Dr. Russell therefore made researches on this fascinating problem, and here details his conclusions.

For many years before the discovery of radioactivity geologists were puzzled by certain coloured areas of exceedingly small diameter which occurred in the mineral mica especially in the varieties of mica known as biotite, cordierite and muscovite. Examined under the microscope these areas were seen to consist of concentric circles of varying diameter at the centre of which was a minute speck of foreign matter. The areas between some of the circumferences of the circles appeared darker than others giving the whole the appearance of a halo and for this reason these areas are now usually called radioactive haloes. Drawings of some of these haloes are given in Fig. 1. The origin of the haloes was never satisfactorily explained by workers in geology. Some geologists regarded them as due to organisms, but the perfection of the circles and the constancy of their diameters in different specimens of mica inclined others to doubt their ascription to anything organic. But if not organic, what? Inorganic? How could anything inorganic, dead, produce these perfect haloes? No answer was suggested which received acceptance by geologists, and this was, perhaps, well. For unexplained facts in any natural science are far better left unexplained than plausibly, but quite wrongly explained. For an explanation which, in fact, is no explanation, by apparently settling the problem may shelve it. If it is left unexplained it is a challenge to every active investigator in the subject and to the more adventurous investigators in allied subjects.

An Unexpected Explanation.

It may be that the explanation lies for ever in the womb of time; it may be that it comes from the unexpected quarter of an entirely different branch of science. With the haloes it was the latter. The accepted explanation of the geological haloes came from physics. The discovery of radioactivity by Professor Becquerel in 1896, the disintegration theory of radioactivity of Sir Ernest Rutherford and Professor Soddy of 1902-03, and the work of Sir Wm. Bragg on the α-particle, were necessary precedents of the work of Professor John Joly of Dublin, who first satisfactorily explained the origin of the haloes in mica, and pointed out their significance in the sciences of geology, chemistry, and physics. A description of the haloes, their explanation and the deductions that may be made from them, form the subject of this article.



THORIUM HALO URANIUM HALO
(Drawn to Scale.)

Fig. 1.
RADIOACTIVE HALOES.

Radioactive elements are the heaviest elements found in nature. Such elements differ from other elements, the non-radioactive or inert elements, in one important respect, and that is that they spontaneously emit from the centre of their atoms—the nucleus—α- or β-particles. We are concerned here with the former of these particles only. The α-particle has a mass of four units, is expelled with a perfectly uniform velocity from all atoms of any one radioelement (but with different velocities from different radioelements), and travels a short but perfectly definite distance in air or other material before it ceases to be observable by any instruments at present known. The slowest α-particle observed travels at the rate of 1,400 million centimetres per second, and the fastest at 2,063 million centimetres per second. Since light itself travels at the rate of 30,000 million centimetres per second, it is seen that α-particles vary in velocity from nearly 5 per cent. to nearly 7 per cent. of that of light. The distance travelled in air at the ordinary temperature and pressure varies from 1.4 to 2.1 centimetres, *i.e.*, from about half to three-quarters of an inch. This distance, as I have said above, is characteristic of

each radioelement. If the distance travelled is in some other medium, in the mineral mica, for example, this characteristic distance will be greater or less than that in air depending upon whether the medium is less dense or denser than air. In mica, a solid material, these distances are only about one-two thousandth of those in air. Suppose now that a small speck of a radioelement has somehow got into a piece of mica, a substance which is particularly easily marked by the *a*-particles expelled from a radioelement, the radiations, which are expelled equally in all directions, will travel a certain distance in the mica and no further. As it happens, they leave a track, which after it has been traversed many times becomes visible, and this visibility is most marked at the end of the path. The points where they stop will be, it is readily understood, on the surface of a sphere the centre of which is the speck of matter and the radius the maximum distance the rays may travel. A section of this surface, including the centre will be, of course, a circle. This circle forms one of the rings of a halo. Since, as I have said, this radius is characteristic of the radioelement producing it, one can actually identify the element which is present, by measuring accurately the distance under the microscope.

Disintegration Series.

Whence comes the multitude of concentric rings, however? They come from different radioelements which are connected with one another as members of what is called a disintegration series. A disintegration series is one in which every member but the last is the parent of the one that follows it, and, except the first, the product of the one that precedes it. So far we have followed the course of the *a*-particle after it has been expelled by the nucleus of the radioactive atom, but what of that atom after the *a*-particle has gone? It is veritably a new atom, and all the atoms that have suffered as it has comprise a new radioelement. If this new element itself expels an *a*-particle its residue in turn will become a third element, and this process will continue until a point is reached when the element ceases to have any radioactive properties. At the present time there are three series of radioactive disintegration series named the uranium, the thorium, and the actinium series. The uranium series comprises eight elements which expel *a*-particles, the thorium six, and the actinium series six. The series are shown diagrammatically in Fig. 2. Now uranium is never found in nature except when accompanied by its seven other *a*-particle-expelling members, nor is thorium without its members nor actinium without its members. Both the uranium and the actinium series, however, are derived from the element uranium. It is the parent of both series. One stream of disintegration runs down the uranium series proper and another down the actinium series. But the number of uranium atoms that break up to form the uranium series is approximately thirty times that which breaks up to form the actinium series. A halo made by members of the actinium series will therefore be difficult, if not impossible, to see in the mica because it coexists with the uranium halo which is thirty times as strong. It is therefore to be expected that in mica there should be two different kinds of haloes only, one due to uranium and actinium products and one due to thorium products. Professor Joly and his pupils in brilliant researches carried out during the seven years before the outbreak of war showed that this is so.

Complex Phenomena.

The phenomena were often very complex, but all could be quite satisfactorily explained by the hypothesis that they were occasioned either by uranium and its products or by thorium and its products. Professor Joly pointed out also that a deduction of importance may be drawn from this. It has always been open for anyone of a speculative and sanguine temperament to say that all elements are radioactive, and that if sufficiently delicate methods for detecting *a*-particles could be invented this would be proved. Now the ordinary methods for detecting radioactivity, the electrical methods, are exceedingly sensitive, much more sensitive than the spectroscope, which at one time was the most sensitive method for detecting matter, but they are quite insensitive compared with the formation of a halo in mica. It has been calculated that in an extreme case the formation of the halo in mica may be as many as 100,000 times more sensitive as a test for a radioelement than the sensitive electrical methods. For the intensity of a ring depends upon the total number of *a*-particles expelled, and so the rate at which they are expelled may be exceedingly small if the time during which that rate has been kept up is very large. Now the rings in the mica may have been forming for as long as the mica has been undisturbed, that is, for a period not to be measured in hundreds or in thousands of years but in millions of years. The fact that mica is found quite unaffected by the presence of many elements which are present in quantities very much greater than the specks of uranium and thorium, which give unmistakable haloes, is proof that such elements are not in the least degree radioactive.

If then some elements are radioactive and others definitely not radioactive, where is the line of demarcation drawn? It is drawn at the elements lead and bismuth. All elements heavier than these are definitely radioactive, all lighter not radioactive. The three disintegration series referred to above continue to disintegrate until they arrive at the element lead, and then disintegration ceases. Lead is said to be the end-product of the uranium series and of the thorium and of the actinium series for this reason. All minerals in nature which contain uranium or thorium or actinium always contain lead too. This lead is not lead that has strayed in from another mineral; it is lead actually produced by the process of disintegration. Now the only reason why lead is described as the end-product is because disintegration appears to cease with it; no one by the sensitive electrical means of detecting radioactivity has detected any radioactivity in it.

Since the war, however, a fresh development has occurred. In 1922 Professor Joly described three new kinds of haloes which could not be ascribed to any known radioactive element. Two of these consisted each of a single ring of very small radius, while the third was a halo of many rings different from, but not unlike, the haloes from uranium and thorium. Drawings of some of these haloes to scale are shown in Fig. 3. They were proved to be genuinely different from, and not mere distortions of known haloes, for in the same mica were found with them haloes of uranium and thorium agreeing in every respect with such haloes in other specimens of mica. Professor Joly was consequently justified in concluding

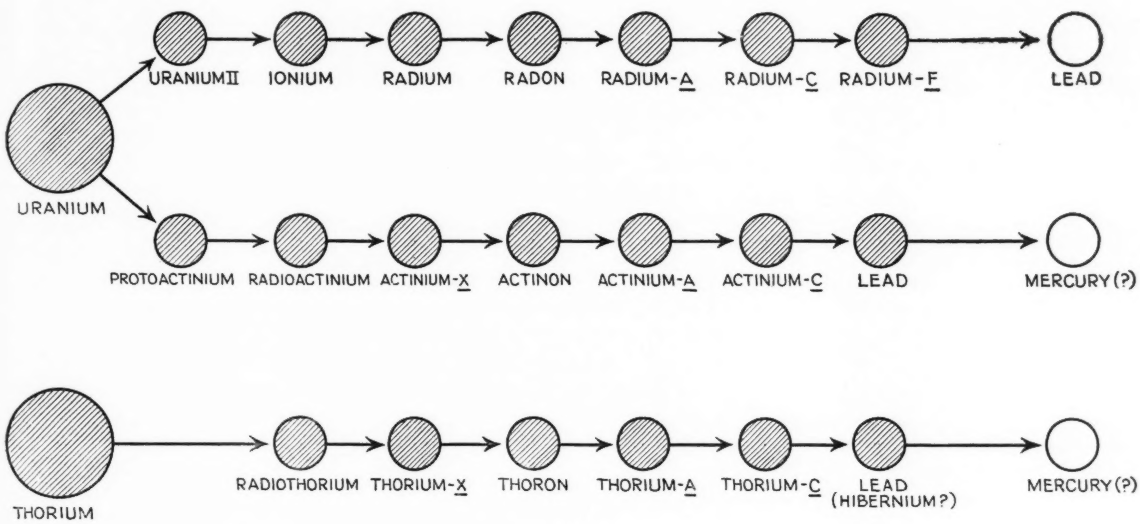


Fig. 2.
THE URANIUM AND THORIUM DISINTEGRATION SERIES.

that these haloes must be due to radioelements, and as these elements were not known they must be new elements. No other evidence, however, was available because the very small speck of matter from which the halo was formed was too small to be analysed by ordinary chemical methods, *if it were there.* For note, it need not be there. It had to be there at one time, but the very process which led it to expel the radiation which formed the halo may have gone to completion, and consequently the element that was once there may have been wholly transformed into another kind of matter. Professor Joly named the element which gave the smaller of the two single rings *hibernium,* after his native country Ireland, and called the halo that resembled a thorium halo an *X*-halo.

In 1926 two Japanese workers, Messrs. Iimori and Yoshimura, discovered haloes in Japanese biotite not unlike those found by Professor Joly. Some of these haloes resembled the *X*-haloes, others a combination of the *X*-halo and one or both of the two very small rings discovered by Professor Joly (see Fig. 3). The Japanese at once concluded that here was no new element; the haloes were those of actinium and the products of the actinium series.

And certainly the measurements of the radii of the rings of the Japanese haloes (which were called provisionally Z-haloes) agreed with the rings to be expected if they were caused by α-particles from products of the actinium disintegration series. Messrs. Iimori and Yoshimura were inclined to deny the commonly-accepted view that the actinium series is connected genetically with the element uranium, for obviously if it were genetically connected with uranium it would always be found with uranium and never found without uranium. And here in the Z-haloes there was clearly no uranium, for if there was, the uranium halo would show itself plainly. Moreover, they added, these very small rings which are included in some of the Z-haloes are undoubted evidence of new elements, namely, of the new elements from which the actinium series is sprung. They regarded therefore the actinium disintegration series as sprung not from uranium but from another element. Further, they regarded Professor Joly's X-haloes as identical with their Z-haloes, and consequently due to actinium products. They did not consider the origin of the two small rings found by Professor Joly, one of which had been ascribed by him to a new element hibernium.

The whole of the evidence relating to haloes which could not be ascribed to the elements uranium and thorium was reviewed by the writer during the Summer, and although in some ways my conclusions agree with those of the Japanese workers, in others they are different. I took as a working hypothesis that the number of new elements likely to be found on the earth at this date is very small, and concluded consequently that the hypothesis of new elements as causes of the unexplained haloes should not be resorted to before an explanation in terms of known elements had failed.

Recent Discoveries.

It is now well-established that between the lightest element, hydrogen, and the heaviest, uranium, there are only ninety elements, and with the recent discoveries of the elements rhenium, illinium, and masurium, there now remain two elements only to be discovered. Personally I do not believe that either of these two undiscovered ones will ever be found in detectable amount in the Earth, but my reasons for this conclusion cannot be given here. Both these elements are heavier than lead (one stands three places, the other five places above lead), and therefore if they exist there is an overwhelming probability that each would be radioactive. Why then should not one of them be Professor Joly's hibernium? The one which stands three places above lead might possibly be hibernium, since it is not impossible that in disintegration it would expel one particle only; the other, however, would almost certainly expel three α-particles in the course of its disintegration, and consequently would not show itself in the mica by a single circle. Hibernium might therefore be the element three places above lead—number 85 as it is called.

A Point Overlooked.

It is possible, however, to explain all the "unexplained" haloes without dragging in undiscovered elements if two not unlikely assumptions are made. The first is that the specks of radioactive material which give the haloes may not have been present in the mica since the Earth's crust went solid, but have been deposited there at a later date by chemical agencies, such as percolating water, acid, or alkali. The second is that the so-called end-products of the three disintegration series may possess a feeble radioactivity, which, though certainly undetectable by the present electrical methods of radioactivity, may yet be sufficiently active to mark the mica over the long years of geological epochs. The first of these points has apparently been overlooked by the workers who described these new haloes. A uranium mineral or a thorium mineral must, of course, contain every element which is a member of its disintegration series (see Fig. 2) if it has remained untouched for more than a certain minimum number of years, but as Professor Marckwald of Berlin and the writer showed many years ago, certain of the elements may be completely removed from the mineral, others partially removed, and others altered not at all. The simple explanation is that some elements are more easily dissolved out of the mineral by the chemical agencies than others. I have applied these ideas to both uranium and thorium minerals, and considered the variants from the normal uranium and thorium haloes likely to be ascribed to this effect. Uranium minerals would be expected to give three variants, one due to the escape of the gaseous product of radium, a second to the isolation from the mineral of actinium, and a third due to the isolation of the end-product lead. From thorium minerals one variant only would be expected; that due to the isolation from the mineral of the end-product lead. The first of these variant haloes, that from the gaseous product of radium, has already been discovered by Professor Joly. The second is, I think, the X-halo of Professor Joly and the Z-halo of the Japanese workers, as the latter have already concluded; that is to say, X-haloes and Z-haloes are simply the normal haloes of actinium. There is however, no need to conclude,

as the Japanese workers did, that the existence of such haloes proves that actinium must be genetically independent of uranium. The evidence from other branches of radioactivity that actinium is genetically connected with uranium, as indicated in Fig. 2, is very strong. We escape conflict with this evidence, and at the same time explain the *X*- and *Z*-haloes by asserting that the actinium which has produced them has been removed by some chemical agency from uranium, from which it differs remarkably in chemical properties.

In ascribing feeble radioactivity to the end-products, lead, I stand on less secure ground. It is known that the feebler the emission of α-particles by an element, that is to say, the smaller the radius of the ring which it can make in the mica, the stabler is the element. An element which gives a ring of very small radius might easily appear to be wholly stable and not at all radioactive. Now, as I have mentioned above, lead is a "border-line case" in this respect. The atoms composing lead derived from disintegration are known to differ in radioactive properties and also in atomic mass; some of the atoms are not radioactive at all. For reasons too complex to be given here I have concluded that the atoms of atomic masses 208 and 209 are feebly radioactive, those which are heavier than these figures are, as is well-known, very radioactive, and those lighter quite inactive. Of the two border-line cases the atom of mass 209 is likely to be the more radioactive and therefore the ring which its α-particles could make in the mica would be larger in radius than that made by the atoms of mass 208.

New Interpretations.

Now it is established that the element most likely to be dissolved out of a thorium or a uranium mineral is lead, and it is quite certain that if the lead were radioactive the halo it would give would be smaller in radius than that due to any known radioelement. Also it is certain that the lead in a thorium mineral has an atomic mass of 208, and it is probable that such lead in a uranium mineral as is sufficient to produce a halo has an atomic mass of 209. The statements of the last three sentences make it not improbable that the smaller of the two single rings discovered by Professor Joly is due to lead from a thorium mineral and the larger to lead from an uranium mineral. If this is so, hibernium is not a new element; it is a particular kind of lead with a property that had not been hitherto suspected in it, namely, radioactivity. Since, however, every radioactive product which expels a radiation is given a distinctive name, this substance need not be deprived of the excellent name of hibernium, if work in the future should confirm this supposition of mine.

Since the larger of the two smaller rings is ascribed to lead from a uranium mineral, it ought to be found not only by itself, as Professor Joly found it, but also

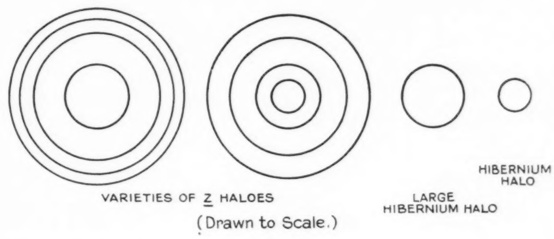


Fig. 3.
THE NEWLY-DISCOVERED HALOES.

with actinium haloes, whenever actinium and lead happened to have been dissolved out together from the original uranium mineral. This has actually been observed in several *X*-haloes and *Z*-haloes. They contain a small ring of the same radius as the larger of the two rings which Professor Joly found by themselves.

To sum up, then. Haloes are records of radioactive disintegrations that have occurred in the past as well as of those occurring in the present. In the former case the elements in the minute specks of matter that have given rise to haloes have disappeared on disintegrating into other forms of matter, but their works live on after them. The fewness of the types of haloes is proof that radioactivity is not a general property of matter, but one belonging to a few elements only. The constancy of the sizes of the rings of any particular kind of haloes in minerals of different geological ages is proof that the rate of disintegration of such elements in the remote past is the same as that in the more recent past. Finally one (probably the simplest) interpretation of the three different kinds of so-called unexplained haloes is (*a*) that uranium and thorium minerals have not always lain undisturbed throughout the long course of geological time, but have occasionally been subjected to certain chemical reagents which have caused some of the constituents to be removed from them, and (*b*) that the course of disintegration which begins with the elements uranium and thorium does not end as has been usually thought at the element lead, but in part continues to an element which lies two places below lead, namely, mercury (see Fig. 2). (A general account of Professor Joly's work in a non-technical form is given by him in the *Journal of the Chemical Society*, Vol. 125, p. 897.)

Refrigerating Machines and the New Law.

By T. C. Crawhall, M.Sc.

The Science Museum, South Kensington.

Artificial cold may not seem to be wanted at Christmas, but actually new laws will make the use of household refrigerating machines desirable the whole year round. Next month even your butter and bacon will be affected.

THE Public Health (Preservatives, etc., in Food) Regulations, 1925, one half of which are now in operation, will have a far-reaching effect on the food of the nation. It is a well-known fact that many preservatives in general use are injurious to health, and the regulations, which will be entirely in force by July, 1928, lay down in clear terms what may and what may not be used. Sugar, salt, saltpetre, nitre, alcohol, and vinegar are strictly preservatives, but as their effect is not injurious they are not included in the legislation, and of other preservatives a small maximum is permitted. It is specified that a preservative refers to any substance which is capable of retarding, or arresting, the process of fermentation, acidification, or other decomposition of food, or of masking any of the evidences of putrefaction. In addition to preservatives most of the colouring matters now in use are prohibited. The following is the schedule of operations, of which the first two are already law :—

Foodstuffs Affected.

(1) All foods except those specified below.

(2) Bacon, ham, egg yolk, and articles of food containing preservative necessarily introduced by the use in their preparation of preserved margarine.

(3) Butter, cream, and articles of food containing preservative necessarily introduced by the use in their preparation of preserved bacon, preserved ham, preserved egg yolk, or preserved cream—1st January, 1928.

(4) Articles of food containing preservative necessarily introduced by the use in their preparation of preserved butter—1st July, 1928.

Those persons responsible for the storage and transport of goods affected by the regulations have already had to make the necessary arrangements for their preservation, but this in itself is not sufficient. Once the food leaves the retailer precautions must be taken by the purchaser for its preservation, otherwise the amount of wastage will be excessive. In the past it has been difficult to keep certain articles of food during the summer months, but soon this problem will present itself almost the whole year round. Before these regulations came into force the small amount of food lost due to putrefaction hardly warranted any serious consideration, but the problem must now be looked at in a different light. Some form of refrigerator will therefore be highly desirable in even the smallest house, and in future it will be looked upon as part of the kitchen equipment as necessary as a boiler or a cooker.

It is the object of this article to describe some of the more successful types of refrigerators from the point of view of their construction. Although this may appear to be exceedingly simple, the development of the refrigerator is a triumph of modern science, embodying as it does many physical laws which have only recently received a practical application.

Certain articles of food deteriorate less quickly in winter than in summer. It is therefore obvious that a reduction in temperature is all that is required for their preservation. This elementary fact has, of course, been long recognized, as before the advent of refrigerators it was usual to keep perishable goods on a stone or marble slab or in a cool cellar, or to wrap the container in damp cotton or flannel, the ends of which rested in water.

Unknowingly the person using the latter method was employing a process which is the basis of almost every type of refrigerator, namely, the process of evaporation. It is an elementary physical law that when any body changes its state, for example, from solid to liquid or from liquid to the gaseous state, a transfer of heat takes place. That is to say, a body changing its state in the way described will require the addition of a quantity of heat known as the " latent heat of fusion " when the change is from solid to liquid, and the " latent heat of evaporation " when the change is from liquid to gaseous state. Conversely, a definite amount of heat is given up by a body in changing from the gaseous to the liquid or from the liquid to the solid state, but this is of less concern when considering refrigeration.

The Ice Box.

The simplest form of refrigerator is the ice box, but its construction is not quite as simple as it would appear to a casual observer. To preserve food it is necessary not only to maintain a low temperature

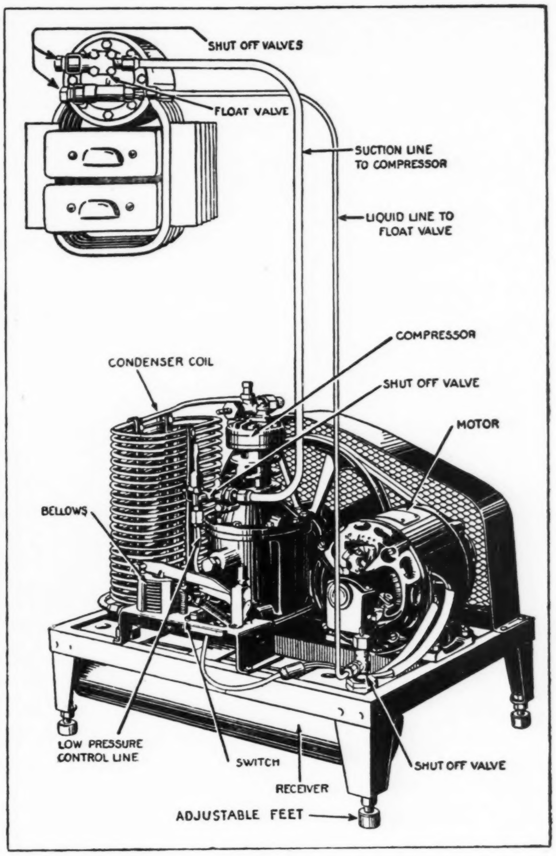
but also to maintain as dry an atmosphere as possible. The ventilation of the box is a very important item, and is the real difference between the effective and an inferior ice box. As its name implies it is simply a box with a compartment that must be kept supplied with ice. The ice in melting requires heat, which it obtains from the interior of the box, and so lowers the temperature of the contents. In order that as small an amount of heat as possible is taken from the outside air, the box must be covered with some form of insulating material, such as granulated cork, cork slabs, asbestos, or charcoal. This, together with ventilation, are the two things to be looked for in a good ice box.

The insulation may take the form of a double wall, with a dead air space between, or better still with the air extracted after the manner of the well-known vacuum flask. A perfect vacuum is the finest possible form of insulation.

Mechanical Refrigerators.

Nowadays there are on the market many refrigerators which do not require the use of ice or of any other substance requiring renewal. It is not considered necessary here to describe the construction of the cabinet, but only of the mechanical plant which replaces the ice in the ice box. In fact many of the machines are designed to be adapted to an existing ice box, which consists, as before described, of a strongly constructed well-ventilated cabinet covered with some heat-insulating material. The interior must be capable of being easily cleaned and must be damp proof. It is usual to arrange a number of trays, which may be filled with water to produce small blocks of ice, in close proximity to the cooling unit.

It has been explained already that in all the refrigerators under consideration the refrigeration is performed by the change of state of some substance, and with the exception of the ice box this change is from the liquid to the gaseous state. In the case of the Frigidaire Automatic Electric Refrigerator the medium employed is sulphur dioxide, which changes its state or "boils" under atmospheric pressure at a temperature of 14° F., that is, 18° F. below the freezing point of water. To understand more clearly what takes place at this temperature we should consider the analogous case of water. If water is heated from the room temperature to a temperature of 212°F. any further addition of heat will convert the water into steam and, provided the pressure remains that of the atmosphere, no amount of heat added will raise the temperature of the water above 212° F. In the case of sulphur dioxide the same conditions take place



THE "FRIGIDAIRE"—A TYPICAL MECHANICAL REFRIGERATOR

at a temperature of 14° F., and as the temperature inside the refrigerator is considerably above this the heat required to produce the evaporation of the sulphur dioxide is extracted from the contents of the cabinet, cooling them in the process.

In principle then, this type of refrigerator is simply a vessel containing the refrigerant in the liquid state which, on evaporation, extracts heat from the contents of the cabinet. The remainder of the plant is concerned only with the recovery of the gas and its conversion to a liquid, thus making a complete and continuous cycle, and is placed outside the insulated cabinet. The gas is extracted from the cooling unit by a compressor driven by a small electric motor and its pressure raised to about 55 lb. per sq. in. By this means the temperature of the gas is raised to about 90° F., according to an elementary physical law that when a gas is compressed its temperature is correspondingly increased. The gas at this higher temperature is then passed on to a condenser, where

the heat it has taken from the refrigerator is extracted and the gas reconverted to the liquid state and passed back to the cooling unit. The condenser takes the form of a copper coil through which the gas passes, and either water or air may be used for the purpose of cooling. In the latter case air is driven over the copper coil by a fan driven by the electric motor.

This briefly is the mechanism of the refrigerator working with a compressor. The remainder of the apparatus is mainly for the purpose of increasing the efficiency of the plant and for obtaining an automatic control. This is so arranged that once the plant is started no further control or regulation is necessary; in other words, a thermostatic control is employed. In the Frigidaire the refrigerating unit acts as the thermostat. It has been explained that when a gas is compressed its temperature is increased. It will be clearly seen then that the gas must have a definite fixed temperature corresponding to a given pressure. The converse of this law is used for controlling the plant, namely, that when the temperature of the cooling unit has reached a desired minimum the gas in the cooling unit is at a definite known pressure, and this pressure is communicated to a bellows operating an electric switch controlling the motor. At this lowest temperature the switch is out and the motor stopped. As the temperature in the cabinet rises, the temperature, and consequently the pressure, in the cooling unit rises correspondingly. This pressure is transmitted to the bellows which in turn closes the switch and restarts the motor. The cooling unit is of unique design, consisting as it does of a small cylinder or "header" into which run a number of coils which increase the cooling surface and enhance the efficiency. The surface is further increased by the addition of fins to these coils. In the header is fitted a small float valve which regulates the quantity of liquid in the cooling unit, and thereby automatically controls the operation of this portion of the plant.

Other Designs.

Another refrigerator of this type, the Servel Automatic Electric Refrigerator, only differs from the Frigidaire in details of design and in the use of methyl chloride in place of sulphur dioxide as the refrigerant. The compressor and fan are duplicated and the cooling unit is immersed in a tank containing brine. Automatic control is effected, as before, by the operation of the gas pressure in the cooling unit on a bellows connected to the motor switch.

The principle of the A-S refrigerating machine is the same as the two just described, namely, the compression cycle, with sulphurous acid as the refrigerant, although the design is entirely different. It consists of two hollow bronze spheres mounted on a shaft which is rotated by means of an electric motor. One of these spheres acts as the evaporator and is immersed in a brine tank, the cooling being accomplished by the automatic circulation of the brine. The other contains the remainder of the mechanism.

Motorless Refrigerators.

Having discussed three types of plant in which a compressor is used, we now turn to types of machines in which all mechanical moving parts are eliminated. The foremost of this type is the Electrolux, in which the cycle is continuous. All that is required for its operation is some form of heating and cooling units. The heating is usually accomplished electrically and the cooling by means of water, both of which are available in the modern house. The refrigeration is accomplished in the same manner as in the preceding plants, namely, by the change of state of a liquid, in this case ammonia, but the remainder of the plant is unique and exceedingly ingenious.

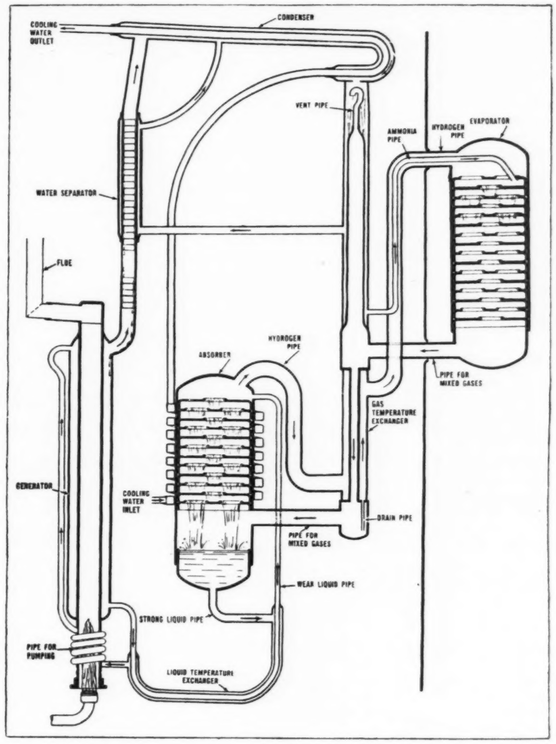
The apparatus consists of a number of steel vessels and pipes welded together and hermetically sealed after the introduction of the necessary chemicals. The cycle of operations will be readily understood by referring to the diagrammatic illustration opposite.

Heat is applied to the generator, which contains a solution of ammonia in distilled water. The ammonia gas thus driven off is condensed in a water-cooled condenser, having previously passed through a water separator, the object of which is to remove all traces of water. From the condenser the ammonia passes to the evaporator, which consists of a series of horizontal trays and is the only part of the plant actually inside the insulated portion of the cabinet. The liquid ammonia on these trays evaporates reducing the temperature of the evaporator and consequently of the cabinet and its contents.

In order to maintain the flow of the refrigerant it is necessary to have a difference of pressure in the various parts of the system. In the plants previously described this is done by means of the compressor. In the Electrolux it is effected in a unique manner by the adoption of a physical law, known as Dalton's Law, which states that "the total pressure of a mixture of gases in a given space is the sum of the separate pressures which would be exerted by each of the gases alone in this space." As there are no valves in the apparatus the total pressure throughout must be the same, whilst the ammonia pressure will vary from a maximum in the generator to a minimum in the evaporator. The difference is supplied by an

inert gas, in this case hydrogen, which does not participate in the refrigeration but only serves to equalize the pressure, and which circulates between the evaporator and absorber. The mixture of hydrogen and ammonia flows from the evaporator to the absorber, where the ammonia is redissolved by the weak liquid which is led by a pipe from the bottom of the generator into the top of the absorber, where it flows over a series of trays. The hydrogen is thus liberated and returns to the evaporator. Owing to the necessity of keeping the generator at a higher level than the absorber the return of the strong liquid to the generator required some ingenuity, and is accomplished by heating the pipe leading from the absorber. In this way a pumping action is obtained by slightly boiling the liquid, forming bubbles which carry over the remainder of the ammonia solution. Thus the whole cycle has been completed, and it remains now only to explain a few of the refinements which help to increase the efficiency and continuous working of the plant. The whole plant takes up very little space and needs no attention as it is thermostatically controlled. It is also arranged that the heat is cut off if for any reason the supply of cooling water should cease. It should be pointed out that the plant is entirely free from noise and vibration owing to the absence of all moving parts.

The heat extracted from the evaporator is given up by the gas on absorption and is carried away by a circulation of cooling water round the absorber. This water is then utilized for the condenser. The weak liquid remaining in the generator after the evaporation of the ammonia is warm, and before going to the absorber passes through a liquid temperature exchanger where it gives up some of its heat to the strong liquid. Another temperature exchanger is needed for the gases, the hydrogen which is warm from the absorber giving up some of its heat to the mixed gases before entering the evaporator. The water separator previously mentioned calls for a little further explanation. It is natural that a small amount of water will be carried over with the ammonia, and as it would be disadvantageous to have this in the evaporator it must be removed. This is done primarily by a series of baffles, the upper portion of which are surrounded by an annular space through which circulates ammonia from the condenser. The ammonia from the generator is thus partially pre-cooled, and gives up the water which returns over the baffles to the generator. Any hydrogen which may find its way into the condenser when the plant is not working is returned to the absorber by means of the vent pipe.



"ELECTROLUX"—THE MOTORLESS TYPE

Another machine of the motorless type is the Pulsometer Motorless Refrigerator, in which the "absorption" principle is employed as in the Electrolux. The plant is extremely simple but the cycle is, however, not continuous. Once a day it is necessary to turn on the heat which must be applied for about one and three-quarter hours, at the end of which time it is automatically cut off. During this period the refrigerant which is dissolved in water is evaporated in a boiler and passed to a water-cooled condenser. The liquid refrigerant then flows into a series of tubes in the insulated cabinet, and refrigeration commences. The cooling water is cut off from the condenser and now circulates the boiler. Cooling of the cabinet is effected by the evaporation of the refrigerant, as before, which is condensed and re-absorbed by the water in the boiler. The length of time taken by this process will depend entirely upon the amount of heat which finds its way into the cabinet, but under normal conditions of working only one heating period will be required each twenty-four hours, during which time the temperature in the cabinet will rise very little, if at all.

A Bird Census in the French Alps. II.

By E. M. Nicholson.

In completing an account of a sectional bird census, the writer describes further excursions. General conclusions are now made about the various birds observed, including those dealt with in the previous article.

FROM the previous expedition we returned to our base —Huez-en-Oisans, a village clinging to the flank of the Grandes Rousess *massif* at an elevation of about 4,900 feet. It was obvious enough that while little of practical value could result from pushing the bird census any higher than 10,000 feet, much could be gained by its continuation downwards to valley level. Behind Huez, and almost due north of the village rises a *signal*, or grassy alp, whose flat head just surmounts the 7,000 feet contour. It forms a wall across the upper end of a shallow combe which contains the village, and turning into a pretty valley, drops steeply southward to the *tiefland* of the Romanche at about 2,370 feet. Here was a vertical distance not far short of a mile—a test of ornithological endurance.

First Excursion.

I attacked it in two parts. The first was a zig-zag sectional census taken on 1st August 1927, up the shallow combe running northward to a height of c. 7,040 feet on Huez *signal*, the starting point in the village being at c. 4,900 feet. It was begun at about 7 a.m., progress at first being extremely slow owing to the congested bird population, and the count was not completed until noon. I worked alone. The chosen field of operations had probably at this time (of the year and day) as dense and representative a bird population as almost any of equal altitude in the alps—at least so far as its lower slopes were concerned. It consisted first of the mean, squalid, compact, stone-built village of Huez (c. 4,900-5,000 feet: VI on map opposite); then little cultivated patches, of potatoes and cereals for the most part, gradually giving way to hay, with a few bushes and dwarf trees (birch, sycamore etc.) straggling up the rivulet between about 5,000-5,300 feet (sect. V on map). Lastly, above the tree limit, where the little stream I had followed up dwindled and ceased to count, was a good stretch of mown hay interspersed with countless boulders, some of the great size, and traversed by three sections of the zigzag road to l'Alpe (section IV; c. 5,300-5,700 feet). The first of these sections (Huez village) extended for 280 paced yards; the second (valley fields) for 720; the third (valley meadows) for 800, making a total of 1,800 paced yards or roughly one mile. Above this measurements are taken as nearly as possible from the map, for which purpose the French Etat-majeur is very inferior even to our own Ordnance survey—they are necessarily rough. There was a further mile of very steep hillside, facing south, covered with short turf, used for grazing by belled cattle and goats, and traversed along a contour (about 6,500 feet) by a very ingenious canal from Lac Blanc to Villard Reculas, ending in a rather long (c. 300 yards) almost flat top. This is section II on the map.

From here I doubled back along the crests of the *signals* a further mile to Villard-Reculas *signal*—6,480 feet. (Huez signal—the other summit—was 7,040 feet, and neither of these sections fell anywhere so low as 6,000 feet). Thence down to the pyramid cairn above Huez and back along the hillside path to the point of last crossing the road to Alpe, at the junction of II and IV. This last section (III) was also about a mile in length. The accompanying map will make clear this unconventional course, but it is very far from being drawn to scale.

The results of this census (see table p. 402) brought out strongly the need for continuing work down to valley level, a fall of a further 2,500 feet. The difficulties were obvious, and I faced the task with reluctance. In the event it proved impossible for me to cover a path sufficiently regular to allow any serious estimate of the acreage involved, or to identify a considerable minority of the elusive small silent birds, largely young of the year, which in some places thronged the trees. The date—5th August—was moreover the latest on which such an enterprise could profitably be undertaken, owing to imminent passage movements.

A Second Attack.

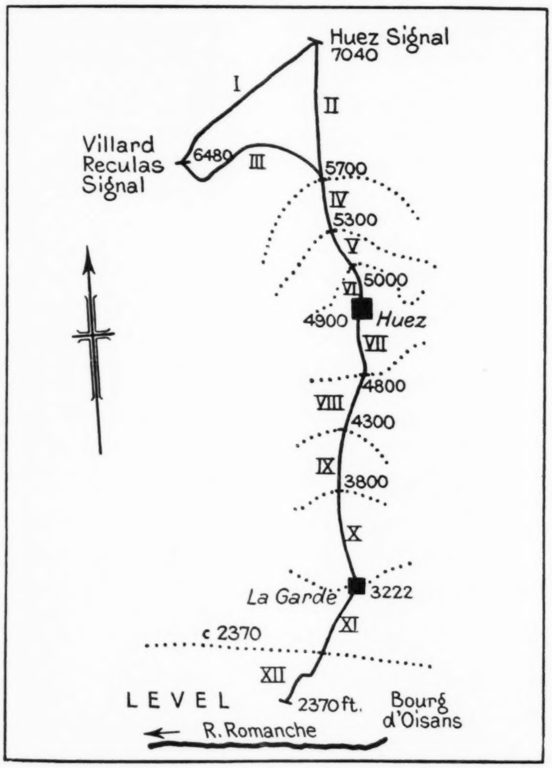
The field of operations extended from Huez village down to the fields by the Romanche near Essouilleux (west of Bourg d'Oisans)—a map bee-line distance of little more than a mile and a half, but actually about two and a half allowing for elevations and the general curve. Owing to the many complications no sort of scientific measurements of the various subdivisions was possible, but having to get back to Huez at a fast uniform rate without halts I took the times for each to give some basis for comparison. (As the time from the bottom was 50 minutes a rough percentage of

distance is obtained by simply doubling the time-figure for each section). The sections of this further extension were as follows :

VII. Huez, from Hotel des Grandes Rousses to the old church and cemetery ; c. 4,900-4,800 feet. A short road section of perhaps a third of a mile, partly village, the rest open, corn etc. Time up 6 mins. ; 12 per cent of whole.

VIII. Huez old church to the 'grotto'—a cascade over petrifying mud and moss on the short cut at c. 4,300 feet. First part of the main drop—uncultivated hillside climbed by the zig-zag road and wooded with smallish trees ; ash dominant, some wych-elm, cherries, and a species of pyrus, also a wild clematis. Time 8 mins. ; 16 per cent of whole.

IX. From grotto to the farm—the only considerable group of buildings between the villages of Huez and La Garde. Central portion of the main drop (to c. 3,800 feet) becoming more wooded ; Scots pines on the flank of the valley impinging on census track ; walnuts appear ; now several considerable torrents. Time 8 mins. ; 16 per cent of whole.



MAP OF THE EXCURSIONS.

The birds observed in the numbered sections of the map (not to scale) are listed in the table overleaf, which shows that the main division between upland and lowland birds may be drawn at about 5,300 feet, *i.e.*, between V and IV above.

THE VILLAGE OF HUEZ-EN-OISANS.

The track of the bird census here described, of which the village was practically the central point, may be traced from right to left across this picture, roughly a quarter of an inch below the sloping skyline. Villard Reculas *signal* is at the top right hand corner.

X. Farm to La Garde (3,222 feet)—lower part of the main sweep, now flattening out ; some corn ; some dry stony slopes with bushes of blackthorn type ; walnut the dominant tree in many parts ; village of La Garde small and open. Time 16 mins. ; 30 per cent of whole.

XI. La Garde down to valley level (c. 2,370 feet) The last terraces ; again very steep and stony ; scrub ; few decent-sized trees ; false acacia dominant. Road crosses in many zig-zags. Time 13 mins. ; 26 per cent of whole.

A further section was taken out across the flat *tiefland*, striking almost due west from the bottom of the short cut above Sarennes Mills, then along right bank of Sarennes river to the bridge at Essouilleux, and over along the apple avenue to the point where it peters out near the Romanche fields, all hay or pasture, hedges of shade trees, clumps of willow and poplar. This section (numbered XII on map), had a length of about 20 per cent. on the basis of those given above.

Results confirmed and extended those of the previous work, although there was a larger error than in any census I have ever undertaken. (Only the species and rough proportions for this lower part are reliable and full ; not densities or precise numbers as there were points of swarming activity where only estimates

COMBINED TABLE OF CENSUS RESULTS.

Species	α	β	γ	δ	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total.
Altitudes in feet approx.	5624—7503	10263	7240	6780	6480—7040	5700	6480—5700	5300	5000	4900	4800	4300	3800	3222	2370	2370	
Carrion Crow...	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	7
Chough ...	-	-	-	-	-	-	-	8	-	-	-	-	1	-	-	-	9
Alpine Chough	2	5	1	24	-	-	-	c 232	-	-	-	1	-	-	-	-	265
Jay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	4
Chaffinch ...	-	-	-	-	-	-	-	-	10	1	8	7	38	13	2	4	83
Goldfinch ...	-	-	-	-	-	-	-	-	4	2	9	-	2	-	11	2	30
Serin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1
Linnet... ...	-	-	-	-	-	-	-	-	17	-	-	-	-	-	-	-	17
Snowfinch ...	-	-	-	8	-	-	-	-	-	-	-	-	-	-	-	-	8
Crossbill ...	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	6
Yellowhammer	-	-	-	-	-	-	-	4	9	-	4	1	4	1	1	2	26
Ortolan ...	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1	-	3
Skylark ...	-	-	-	-	2	5	2	-	-	-	-	-	-	-	-	-	9
Short-toed Lark	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2
Alpine or Water Pipit ...	1	1	1	17	15	4	2	3	-	-	-	-	-	-	-	-	44
Tree Pipit ...	-	-	-	-	-	-	-	8	12	-	11	-	-	-	-	-	31
White Wagtail	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3
Grey Wagtail...	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1
Red-backed Shrike	-	-	-	-	-	-	-	-	5	-	-	-	-	4	2	-	11
Great Tit ...	-	-	-	-	-	-	-	-	-	-	-	3	8	5	-	1	17
Blue Tit ...	-	-	-	-	-	-	-	-	-	-	-	1	6	3	4	-	14
Crested Tit ...	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	2
Willow Tit ...	-	-	-	-	-	-	-	-	-	-	-	-	2	2	-	-	4
Marsh Tit ...	-	-	-	-	-	-	-	-	-	-	-	-	-	5	1	2	8
Coal Tit ...	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	2
Treecreeper ... (*C. brachydactyla*)	-	-	-	-	-	-	-	-	-	-	1	1	4	-	-	1	7
Nuthatch ...	-	-	-	-	-	-	-	-	-	-	-	-	2	[illegible]	-	2	4
Wallcreeper ...	-	-	-	1	-	-	-	-	-	-	-	-	-	[illegible]	-	-	1
Alpine Accentor	-	-	-	1	-	-	-	-	-	-	5	2	3	4	[illegible]	-	18
Robin ...	-	-	-	-	-	-	-	-	-	-	1	1	-	[illegible]	[illegible]	1	7
Redstart ...	-	-	-	-	-	-	-	-	-	-	-	-	-	3	4	1	8
Black Redstart	-	-	4	8	-	-	-	-	1	-	2	-	-	-	-	-	15
Whinchat ...	-	-	-	-	-	3	13	13	19	-	-	-	-	-	-	-	48
Wheatear ...	-	-	-	-	-	2	1	2	-	-	-	-	-	-	-	-	5
Rock Thrush ...	-	3	-	2	-	-	-	-	-	-	-	-	-	-	-	-	5
Mistle Thrush	-	-	-	-	-	-	-	-	-	-	-	-	10	-	-	-	10
Blackbird ...	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	1	5
Whitethroat ...	-	-	-	-	-	-	-	-	2	-	-	-	-	-	1	-	3
Garden Warbler	-	-	-	-	-	-	-	-	-	-	1	-	3	-	1	3	8
MelodiousWarbler	-	-	-	-	-	-	-	-	2	-	1	-	3	-	1	-	7
Bonelli's Warbler	-	-	-	-	-	-	-	-	-	-	-	1	3	1	-	-	5
Pied Flycatcher	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	3
Martin ...	-	-	2	-	-	-	-	-	-	-	5	-	-	2	-	-	9
Swift	-	-	-	-	-	-	-	-	-	9	-	-	-	-	-	-	9
Alpine Swift ...	-	-	-	-	-	-	17	-	-	-	-	-	-	2	-	-	19
Green Woodpecker	-	-	-	-	-	-	-	-	-	-	-	1	1	1	1	-	4
Pied Woodpecker	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
Kestrel ...	-	-	-	-	-	1	-	2	2	-	-	-	-	1	-	-	6
Sparrowhawk...	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1
Woodpigeon ...	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
Totals	3	9	8	61	17	15	35	272	85	18	48	19	96	54	42	34	816
Lengths of Sections (approx.)	3 m.	2 m.	2.5 m.	2.5 m.	1 m.	1 m.	1 m.	800 yd.	720 yd.	280 yd.	See footnote *opposite page.						Excl. VII.-XII 14 m.
Acreage included (approx.)		1500			75	75	75	35	20	5							1,785
Density per acre (approx.)		.05			.3	.2	.5	7.8	4.25	3.5							.3

could be made). For convenience, the results are combined opposite in a single table; it is necessary to remember that while sections I-VI and α—δ (dealt with in the first article last month) are pretty exact, VII-XII are only approximate. The sections are for the purposes of this paper re-numbered in order of height, from the top downwards. It must be borne in mind that I and III are together co-extensive with II, since the sparse population at these altitudes could only adequately be recorded by sweeping round over a much wider area. The overlap of the earliest sections γ—α has also to be taken into account; β and γ are the highest sections; α (barren valley), δ (grassy valley with broad stream), I and III alpine meadows and II alpine pasture, are alternative versions of what comes immediately below. From these downwards the count was made in a straight line, the divisions between the sections being fixed at suitable contours. XII is practically flat because it runs across the river-meadows of the *tiefland* floor.

Analysis of Results.

The figures, secured not without dust and heat, bring to light some interesting points. That densities would be lower at high altitudes, and that one species would give place to another during the ascent, were foregone conclusions, but the precision of a census records much that no observer's eye would see. Naturally, if it had been possible to arrange operations with the experience of the count at my disposal I should have been able to improve the divisions; I could have got a clean line of partition between the range of the tree pipit and Alpine pipit at about 5,400 feet, and between marsh tit (*Parus palustris communis*) and willow tit (*P. atricapillus montanus*) at about 3,700 feet if I had known in advance where their frontiers lay. Even so the cleavage is striking enough. Out of forty-four Alpine pipits thirty-four—nearly 80 per cent.—occur in the four highest sections, and only three below 5,700 feet, while the thirty-one tree pipits are absolutely restricted to three sections between the 4,800 and 5,500 feet contours, and the

TYPE OF COUNTRY AT 5,000 FEET, NEAR HUEZ.

View taken from a standard of the aerial cableway near the village, cornfields being seen in the foreground.

whinchat, the dominant small bird from 5,000 to 6,000 feet, is not recorded either above or below that altitude.

The chaffinch, goldfinch, and yellowhammer are good examples of birds ascending from valley level right to the tree limit, and there stopping short without any previous diminution. Titmice and other strictly arboreal forms naturally drop out at a rather lower level. The wheatear, skylark, Alpine chough, and garden warblers also show a very clearly defined vertical range. It is interesting to notice the upper limits of some common British forms; the martin appears to draw the line at 9,000 feet, the skylark at about 7,000, wheatear and whinchat at 6,000, yellowhammer and tree pipit at about 5,500, chaffinch, goldfinch, whitethroat and red-backed shrike at 5,300 (the tree limit in this part), robin at 4,900, green woodpecker and most titmice at 4,800 or lower, redstart at 3,800, while the blackbird stops short at 3,000. As regards the range of the treecreeper, it must be pointed out that those observed closely enough for certain identification belonged to the non-British form (*Certhia b. brachydactyla*), but not all were properly determined. The zonal distribution of birds like the chough, tree pipit, whinchat, and willow tit (which in Britain seem to have no altitude limits except those imposed through vegetation), is especially notable.

I should perhaps emphasize the fact that these data are given as having been found in this particular case,

* For reasons already stated I have not attempted to give precise figures in the categories marked, since the difficulty of this part of the census resulted in an error which would render close statistical deductions inadvisable. At a guess the average density of Sections VII-XII would be 2-4 birds per acre. But this rate applies to so small a fraction of the total area covered that in any case the average density over all could not rise above .5 per acre. The low estimate of acres for yards in Sections V and VI is due to the restrictions imposed by nature of the ground. It is worth noticing how strikingly the figures form continuous blocks either on the left or right according to the vertical range of the species as indicated by the altitude figures. Each section covers the area between altitudes shown at the head of its column: the two breaches of continuity are indicated by vertical lines.

and are on no account to be taken as general statements of range in Alpine conditions, or otherwise to be applied beyond their obvious and very limited validity. Nothing does more harm than arguing from inadequate statistics. When the chaffinch occurs freely in every section till 5,300 feet, and above that in none at all, the obvious conclusion is justified, but it would be unsafe to conclude that because the white wagtail is only shown in XII it must be exclusively a valley-bottom bird. On the contrary it ranges as high as the grey, if not higher, and not far off the path of this census was a pair living at 6,000 feet. Again, the altitude limits of the whinchat in this locality are by no means of universal application; in the Bavarian Alps and in Tirol I have found it dominant along the valley floors (*tiefland*) at about 3,000 feet and none up on the heights. There are definite limits and definite laws governing their distribution, but it would be optimistic to hope to reveal them by the results of a single small census. The census method is useful in proportion to the frequency of its use. Isolated attempts can suggest lines of attack, and are always valuable if efficiently carried out, but a scale of operations sufficient for comparison is needed to get the most out of the results.

Analysing the distribution by altitude as a whole we find that the main line of division between upland and lowland birds may be drawn at about 5,300 feet, below which the chough, Alpine chough, snowfinch, Alpine pipit, wallcreeper, wheatear, rock thrush, and Alpine swift do not occur, except as obvious stragglers, and above which the forms already enumerated cease to be met.

A Striking Contrast.

The two highest sections (β and γ) harbour five species; the five sections representing roughly 5,700-7,300 feet show twelve; the two following sections (down to 5,000) show seventeen; the next two (down to 4,800) fourteen; the next two (down to 3,800) twenty-two, and the last three, representing the lowest parts of the Alpine region, as much as thirty. Considering that the highest seven sections, with their thirteen species, cover fully six times as much ground as the nine remaining, with their forty-six species, the contrast is sufficiently striking. But though the richness and variety of the avifauna continues to increase all the way down to valley level, the density behaves very differently, reaching its highest figure between 5,000 and 6,000 feet. The presence of all the choughs in the neighbourhood foraging on the path of the census at the time it was taken was, of course, an adventitious circumstance, although this was undoubtedly the most favoured of their feeding-grounds. Yet even if the 7.8 per acre of Section IV were ruled out on that account, the 4.25 of V, immediately adjoining, would unquestionably take its place. Below 5,000 feet the distribution of the population seemed curiously patchy; it was concentrated in little pockets, not always perceptibly more favourable than the intervening practically birdless areas. This concentration was rather more marked above than below 3,800 feet, and the three sections above this contour contained about 46 per cent. of the population recorded in the last count while extending over less than 37 per cent. of the area—not a very striking disproportion. A considerable percentage of the totals are birds of the year; among whinchats, pipits, finches, and choughs this was especially conspicuous. The bird population was very near its maximum at the time; the winter figures must be very small.

Birds of Prey.

A small-scale census can only by accident do justice to the birds of prey, and the number of these included is misleadingly small. Thus on the morning of 8th August I saw on the census area (Section I, tops of the *signals*) one hen harrier, two buzzards, and seven kestrels, all except the first simultaneously. At least one peregrine and one golden eagle also hunted this section, and there was a pair of sparrow-hawks below, of which only one was enumerated. (This bird was responsible for a slight accident to the results, for while identifying some buntings in the corn I heard a sudden clean impact behind me, followed by dead silence, and turning, saw the hen sparrowhawk pass over bearing in her talons some unidentifiable small bird, which had been perched on a tree the other side and had not yet been counted.) The nine hawks on Section I (8th August) were all hunting grasshoppers on an area of about fifty acres.

The distribution of the birds bears not the slightest apparent proportion to the distribution of insects, which at this season teem on the upper slopes, where birds are very sparse. At various test spots above 6,000 feet the average number of grasshoppers put up at every stride was anything up to five; butterflies, from little blues to swallowtails, were at least as plentiful; and there were countless coleoptera and diptera of all kinds, amongst which the horseflies were particularly noticeable. But the birds were mostly down below, preferring a little shade and cover to the living feast of insects.

The Thirst for Speed.

By R. S. Russell, B.A.

The records of the past year, on land as well as in the air, suggest the question how far these achievements are likely to have practical effect on the future of transport. An important new development combining sea and air travel is here foreshadowed.

LOOKING back on the recent triumphs of British skill and workmanship over the rest of the world in producing two more speed records, one wonders where and when this competition for enormously high speeds on land and in the air is going to end. Ten years ago such terrific speeds as 203 m.p.h. on land and 281 m.p.h. in a flying boat were practically unthinkable, but so great has been the progress of engineering in the past few years, that not only has the supposed impossible been achieved, but there are prospects of attempts at breaking both these records being made in the near future.

It is a matter of interest as to whether either of these two achievements is going to be of any practical value in the future development of commercial transport. While there is no limit to the speed of aircraft, it is quite clear that 200 miles an hour is an utter impossibility for any form of travelling on land. Besides the fact that no roads could be made anywhere —except possibly in the yet undeveloped parts of America and Australia—capable of accommodating traffic at that enormous rate, it will be a great many years before any car can be made to run safely and economically at that speed. A revolution in tyre production would be necessary to overcome the heat, and something would have to be devised to bring the car to a standstill within a reasonable distance.

So what it comes to is that the only value of this record is in the test of British pluck and British machinery which, as usual, have shown themselves to be unequalled by those of any other nation. On the other hand, there is no limit to speed in the air except the question of economical working, and thus there is something to be gained by attempting to make records in this mode of travelling.

Long-distance Flights.

The past year has also been noteworthy for the number of long-distance flights which have been attempted, by other nations as well as ourselves, especially across the Atlantic and to the East. This is another phase of travelling in which Britain has led the way for the rest of the world, with the first flight across the Atlantic from Newfoundland to Ireland in June, 1919, by the late Sir John Alcock and Lieut. Sir Arthur Brown, and later with the flights of that pioneer of air travel, Sir Alan Cobham, to the Cape and to Australia. The four successful flights across the North Atlantic, one of which created the present non-stop record, together with the several fatal attempts, have shown that there is a large element of luck in making the crossing by air, without providing any reasonable clues as to the causes of the failures. Now the public are beginning to reali e that it is a waste of valuable lives and machines to make the attempt at the present stage of aircraft development.

Long non-stop flights across land, however, being comparatively safe, are a very important factor in the future of air transport, as they will do much to shorten the length of time of journeys between places several thousand miles apart.

Records by Sea.

As regards travelling by sea, no advance in the speed of the fastest ocean liners has been made for twenty years, since the Cunarder "Mauretania" finally drove the Germans out of the speed competition for the North Atlantic passage in 1907, remaining unchallenged up to the present day. In November, 1926, however, came the announcement from the Italians of the laying down of two 30,000 tonners to be propelled at forty knots, for the Atlantic routes, and now an American concern proposes to build ten ships, each having a gross tonnage of 20,000, capable of a speed of 35 knots, and provided with an equipment for launching aeroplanes at sea. By this means the time for the Atlantic crossing is to be reduced to four days. Moreover, it is claimed that this project will be made an economic possibility by improvements in engineering which will give the requisite increase of speed, at the same time halving the fuel consumption and necessitating only one-third of the crew of present-day liners.

This seems rather a sweeping statement, which needs to be supported by facts, when it is remembered that it is the great cost of high speed in the water which has prevented the British lines from attempting to improve on the "Mauretania's" average speed. Britain undoubtedly leads the world in anything

concerned with shipping and marine engineering, and it will therefore be surprising if the brains of the great Clyde, Mersey, Tyne, and Belfast shipbuilding firms are being outclassed either in Italy or on the other side of the Atlantic. The promoters of this scheme assert, rather optimistically, that the boats will be able to maintain their thirty-five knots in an Atlantic storm. Possibly this may be true, but at the expense of the passengers' comfort. A vessel of the size of 20,000 tons is considered small nowadays for the North Atlantic service, and this size stands less chance of weathering a bad storm comfortably than boats of the tonnage of the " Majestic."

Thirdly, it is intended that aeroplanes shall be launched from these boats while at sea. While this may be possible in calm weather, it will in all probability be an extremely difficult it not an utterly impossible feat in one of the gales for which this particular crossing is noted during the winter months, and which are none too rare in the summer. Thus the quick transport of mails will be largely a matter of luck. However, by 1930 even the vagrancies of the weather may have been overcome by aircraft.

Our home railways have in the past few months been showing a tendency towards reviving the great railway races of the latter part of last century by setting up new non-stop records on the expresses to Scotland. First came the L.M. & S. Company's improvement on the 225-mile non-stop run of the Cornish Riviera Express from Paddington to Plymouth, by running the 10 a.m. ex-Euston and the corresponding train in the opposite direction non-stop between London and Carnforth, 238 miles. Then the L. & N.E.R. went one step further by scheduling the 9.50 a.m. from King's Cross to omit all stops to Newcastle, 268 miles, on four days of the week, and on 26th September the West Coast run to Carnforth was extended to Carlisle in both directions, giving a daily non-stop run of 299 miles. While this was not intended to be made at a very fast speed, the regular arrival of the train before time has induced the railway company to cut eight minutes off the time allowed, and it is possible that further reductions may give an acceleration to an average speed of sixty m.p.h. for the whole distance.

The Great Western Railway locomotive " King George V " recently gave such a demonstration of speed on the Baltimore and Ohio Railroad in the United States that the driver was told to slow down to 60 m.p.h., as the seventy-five miles an hour at which she was travelling was too fast for safety on the permanent way. While this speed is regularly attained on British railways every day, the inferiority of the track in foreign countries makes such a pace at once noticeable, and is the main cause of the regrettable frequency of accidents on the railways of France, because the authorities will persist in maintaining fast schedules regardless of the state of the permanent way.

One wonders what will become the normal speed of all forms of transport in fifty years time. The past half century has seen enormous changes in locomotion. It remains to be seen whether the next fifty years will produce an even greater rate of progress in this direction.

Correspondence.

ANCIENT EGYPTIAN COPPER.

To the Editor of DISCOVERY.

SIR,

Your correspondent's question as to whether the ancients were able to harden copper sufficiently to use it as we do steel is one of perennial interest and controversy. With few, if any, exceptions, Egyptian copper tools are found in tombs or at any rate connected with burial. Now, as these tools are not now hard, and repeated and exhaustive chemical analysis has failed to find anything in their composition which a metallurgist would recognize as a sufficient hardening agent, the question naturally arises, were they ever hard ? Or were they simply funerary objects—to put it more bluntly, undertaker's dummies—in the same way that large rolls of papyrus of the Book of the Dead are often found to have only the first few turns inscribed and the rest blank ?

A partial answer to the question was found by the present writer a few years ago. While carefully examining the small passage which leads southward out of the large chamber called the pit, underneath the Great Pyramid, I noticed in two places bright green patches. On further examination I found that these were at the termination of obvious pick or chisel marks in the living rock, by which the passage had been excavated. Later I was able to return with a hammer and chisel. I found one patch of green was so far gone in chemical decomposition that there was nothing to take away, but the other was a copper point embedded in the rock. It was quite plain what had happened. The workmen had been squatting on his haunches, with his chisel in his left hand and hammer in his right, and perhaps owing to his cramped position and the smallness of the passage, he had hammered it in too deeply, so the point of the chisel had broken off, and had been left there embedded in the rock.

When I got it out, by chipping away all round it, I found it was a piece of copper about the size and shape of the top of my little finger, and the fractured surface on being cleaned showed bright red copper. Later I showed it to Professor Reisner, who said it was practically identical with the copper chisels he was finding in the fifth and sixth dynasty tombs around the pyramid. (The Great Pyramid belongs to the fourth dynasty).

Whatever suspicions one may have of implements found in tombs, here was the remains of one that without a shadow of doubt had been in actual use in a place where an ordinary soft copper tool would not have lasted fifteen minutes. Also, it was not in a place where there might be any possible religious significance in the use of a fine copper tool, as the passage where it was found is very rough work, and it is the only curved passage in the whole pyramid. Many people think it was no part of the plan of the passage system of the pyramid, and quite probably it was only a trial passage to ascertain the quality of the rock on which the pyramid was to be erected.

This piece of copper is now in the British Museum, and assuming, that like all the other copper that has been analysed it is not hard now, how and why has it changed? A possible, but very unsatisfactory, explanation is that some chemical was introduced, possibly quite unrealized by the worker, into the smelting process, and that this chemical element is fugitive, and has evaporated in the course of years and left no discoverable traces. A somewhat parallel case is the phenomenon of iron that after many years strain will get what engineers call 'tired,' and suddenly give way for no ascertainable reason or cause.

Yours faithfully,

Rue el Mokattam, VICTOR L. TRUMPER.
Port Said. *18th October*, 1927.

EMOTIONAL CAUSE OF WHITE HAIR.

To the Editor of DISCOVERY.

SIR,

Recently, while travelling, we got into a discussion on the question of the sudden whitening of the hair. In the group were two chemists. One of the chemists stated that he had seen a man whose hair in two or three days blanched from a dark brown to white. He said the moustache was still brown. In the course of the discussion he told me what some lecturer had said about the cause of such a phenomenon. The explanation did not seem probable, nor had it any scientific ground so far as I could see.

Is it true that stress of strong emotions is able to blanch the hair of an individual over night as is usually supposed to occur, or in a few days as in the case mentioned above? If so, what explanation can be given. A hair is slowly produced, it is more or less uniform in colour in itself and in comparison with other hairs of the same head. It seems impossible that the colouring matter can be taken out of a healthy hair by anything except a strong gas or chemical substance.

Yours respectfully,

University of North Dakota, A. H. YODER.
Grand Forks, North Dakota, U.S.A.

It is true that there are well-authenticated cases of brown or black hair becoming grey in a few days, and a few in which the process occurred in a single day. The generally-accepted explanation is that of Metchnikoff, who showed that a class of white corpuscles called polymorphs make their way out of the blood system, force their way through the tissues, and are able to pass up the centre of the hair eating out the pigment. Under stress of anxiety this may occur quickly.

Why the anxiety in the mind should cause this particular physical disturbance we know not; the train of circumstances is unknown; so it is for many other physical results of mental origin. But we do know that the mind may cause different physical results, and it is not hard to demonstrate what is actually occurring in such a physical result (as, for example, in the case above). It is obviously an inquiry for a psychologist; perhaps, in our time, with the great strides psychology is making, this question too may be answered.

AN ANCIENT FUNERARY URN.

To the Editor of DISCOVERY.

SIR,

I have just seen the photograph and note on the urn recently found at Slapton, and hasten to make a small correction. The height of the urn is five inches, not eight inches. It is, I believe, a very early example of the cinerary urn of Bronze Age II, caught at the point of evolution from the food vessel of Bronze Age I.

Since Mrs. Rackham wrote to *Discovery* two cist-vaens have been discovered on the spot. The entire series of interments are after cremation. The urn and one of the cists are now in the Museum of the Torquay Natural History Society.

The decoration on the collar of the urn, done by impressions of twisted cord, belongs to the class of alternately shaded triangles, and has fairly numerous analogies in the pottery of the Early and Middle Bronze Age, and a geographical distribution from Orkney to the Morbihan, and from Antrim to Yorkshire.

These finds are, apparently, part of a group of antiquities consisting of two "standing stones" which may be menhirs, and an ancient ridgeway running northwards to the borders of Dartmoor. Burial sites are rarely found on or near the south coast of Devon, and since it is more than possible to think of the stone rows of Dartmoor as in some way connected with the great alignments at Carnac, further excavation at Slapton offers interesting possibilities, which the spade may prove or disprove.

Yours sincerely,

H. S. DOWIE,
Natural History Society, *Hon. Secretary*.
Torquay. *3rd November*, 1927.

"COAL GAS AS AN ILLUMINANT."

To the Editor of DISCOVERY.

SIR,

My review of the history of coal gas as an illuminant, which appeared in your June number, drew a letter from Mr. Edward A. Bunyard, in which he suggested that the work of Jean Tardin might with advantage be re-examined. I welcomed the suggestion, as Tardin was the only writer quoted by me whose works I had not examined myself.

Unable then to find time for a visit to the National Library in Paris, where Tardin's work is to be found, I asked a friend to undertake the task. In the gallant fashion of overworked men, he called at the Library on 4th July, obtained Tardin's volume, and made a few preliminary notes, which I have. They are interesting and amusing, but do not deal with the point at issue.

My friend returned on several occasions, to be told each time that the book was *en mains*, that is, "out." Sceptical as to this great interest in Tardin, he forced the explanation that the book had been wrongly re-classed after issue to him and could not be found. Up to the present the search for the truant has been unsuccessful.

Yours faithfully,

London. C. T. DE MOUILPIED.
11th November, 1927.

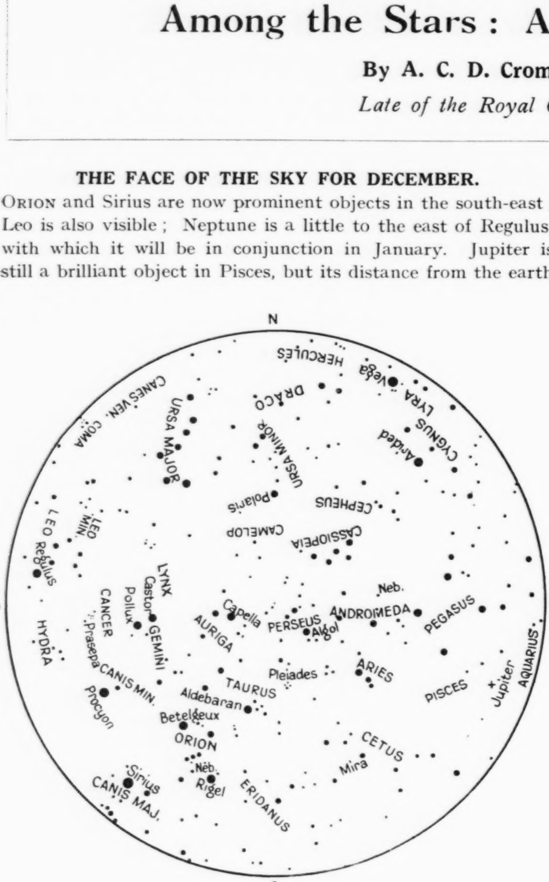
Among the Stars: A Monthly Commentary.

By A. C. D. Crommelin, D.Sc., F.R.A.S.

Late of the Royal Observatory, Greenwich.

THE FACE OF THE SKY FOR DECEMBER.

ORION and Sirius are now prominent objects in the south-east; Leo is also visible; Neptune is a little to the east of Regulus, with which it will be in conjunction in January. Jupiter is still a brilliant object in Pisces, but its distance from the earth



THE HEAVENS AS SEEN FROM LONDON at 4 h. sidereal time: that is 11 h. p.m. on Dec. 7; 10 h. p.m. on Dec. 22.

has greatly increased since opposition in September. The observers at the Jungfraujoch Observatory noted the appearance of a brilliant white spot on the equatorial zone in October. Mira is marked on the map, but it will be a difficult object to the naked eye.

A Lunar Eclipse.

The chief astronomical event of the month is the total lunar eclipse on the evening of 8th December. The first contact of the moon with the earth's umbra occurs just at sunset, 3 h. 52 m. p.m. Totality begins at 4 h. 54 m. and lasts till 6 h. 15 m.; the last contact with the umbra being at 7 h. 18 m.; the penumbral eclipse goes on for another hour, but its only effect is a barely perceptible dimming of part of the disc. The point of interest to note in a lunar eclipse is the amount of illumination and colour of the eclipsed moon; the fact that it receives any light is due to the refraction of sunlight by the earth's atmosphere. The light is generally of a coppery hue, for the same reason that the setting sun looks red; the light of shorter wave-length cannot penetrate such a thick layer of air. I have, however, at times, noted a bluish tinge in part of the shadow on the moon. The amount of light gives us an idea of the average state of our atmosphere in the regions where the moon is on the horizon. The clearer the air the more light gets through. One of the darkest eclipses on record was in October, 1884, when our atmosphere was still charged with a good deal of fine dust from the great Krakatoa eruption in 1883.

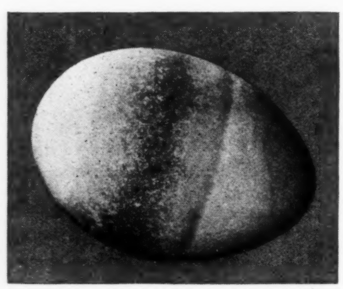
Another useful work during lunar eclipses is the observation of occultations; the dimming of the moonlight enables much fainter stars to be seen. The fairly bright star *iota Tauri* (mag. 4.7) disappears at 4 h. 30 m., and reappears at 5 h. 19 m. It may be possible to observe the occultations of fainter stars; it is well to impress on amateur observers that they can do most useful work by noting the exact time of the disappearance of stars in occultation, getting the error of their clocks or watches by wireless signals, and sending in the results; reappearances need more experience to observe well, and these should not be sent in till some experience has been gained. The most reliable value of the moon's diameter was obtained from occultations observed during eclipses; also Dr. Spencer Jones has recently published accurate values of several of the lunar elements, and of the sun's distance, deduced from a long series of occultations observed at the Cape Observatory.

Humours of Astronomy.

Mr. J. A. Lloyd sends the accompanying photograph of a duck's egg, laid at the time of the solar eclipse in June, which has a stripe of graduated shading round it, resembling the shadow track on eclipse maps. I have found a parallel to this astronomical bird in the hen that laid an egg at Rome in 1680 with a picture of the great comet of that year upon it. (See Dolmage, "*Astronomy of To-Day*," p. 265.)

The Transit of Mercury.

Londoners were unexpectedly favoured by fine weather for this event, and an almost uninterrupted view was obtained from the time that the sun cleared the mists of the horizon up to the last contact. A fine sunspot near the middle of the disc provided an interesting object of comparison; to my eye the planet looked notably blacker than the umbra of the spot. The fact that the planet's position changed visibly in a few minutes brought home to one's mind the rapidity of its motion; it will be remembered that the Greeks called it Hermes, "The messenger of the gods," and pictured it with wings on its feet. My observed times for the third and fourth contacts were 8 h. 27 m. 51 s. and 8 h. 29 m. 17 s.; both, es-



pecially the second, are probably too early, but there is little doubt that the predicted times, which were 8 h. 28 m. 23.9 s. and 8 h. 30 m. 5.2 s. were too late. This was also the case in the 1924 transit; the cause is suspected to be irregularity in the rate of the earth's rotation.

I may perhaps be allowed to mention that this is the fourth transit of Mercury that I have seen; I went to Bournemouth to obtain better conditions for that of November, 1894, but was unsuccessful; I had a glimpse of that of November, 1907, saw the whole of that of November, 1914, and the end of that of May, 1924; it must be reckoned good fortune, in our uncertain climate, to have seen something of four consecutive transits; there will not be another transit visible in England till 1953. Some authorities indicate a transit in May, 1937, but this is an error; there will only be a near approach here, but it is probable that spectroscopists will be able to see the planet projected on the chromosphere. It may just encroach on the sun at some southern stations, including Port Elizabeth.

A New Map of Mercury.

While speaking of Mercury, I may mention that M. E. M. Antoniadi has recently published in *Comptes Rendus de l'Academie* a new map of the planet, based on his observations of it since 1924, made with the great refractor at Meudon; he notes that his map supports that of Schiaparelli fairly closely, but it makes the dark regions broader, which he explains by the diminution of diffraction in his large instrument. There is a similar effect in the great division in Saturn's ring, which appears relatively much wider with large apertures than with small ones. M. Antoniadi strongly supports Schiaparelli's conclusion that the planet rotates in eighty-eight days, thus always turning one face towards the sun. Practically all observers with large instruments in good climates are now agreed on this point. It gives rather a dismal idea of the conditions on Mercury; one side permanently roasted, the other permanently frozen; owing to the unequal orbital motion, two regions, each 45° wide, would oscillate between the two conditions.

Book Reviews.

Architecture. By A. L. N. Russell, A.R.I.B.A. "The Simple Guide Series." (Chatto & Windus. 7*s.* 6*d.*).

In the latest addition to "The Simple Guide Series" Mr. A. L. N. Russell aims at providing the non-technical inquirer with such clues to the significance of architectural styles as will enable him to take an intelligent interest in the structure and design of buildings. He states frankly that the size of the subject precludes the possibility of satisfying; he can hope only to stimulate. He has certainly succeeded. The illustrations, which include both photographs and drawings, have been chosen and designed with a very shrewd conception of essentials. A long series of views, for instance, could be marshalled to show the differences between a "Queen Anne" and a "Georgian" house, and the result might still be confusion. Mr. Russell takes another line, and in the two diagrams facing one another on pages 176 and 177 he gives everything that the student needs by way of a sound starting point for his own investigations. With these two diagrams alone the reader can add immeasurably to the interest of a stroll through any old English town. Mr. Russell's historical survey, which confines itself fairly closely to Western Europe, though it does not neglect the archaic monuments of Babylon and Syria and the more directly influential work of ancient Egypt, is not only singularly lucid but also very readable—two qualities which are not invariably found in close association.

C. E. H.

The Evolution of Man. Essays by G. Elliot Smith, M.A., M.D., F.R.S. Second edition. (Oxford University Press. 12*s.* 6*d.*).

Professor Elliot Smith has taken advantage of the call for a second edition of this collection of three discourses on the Evolution of Man, to make a number of changes in the text by which the value of the book to the student has been considerably enhanced. The extended discussion of the Taungs Ape and Piltdown Man are particularly welcome, especially in the latter case the detailed account of the reconstruction of the brain case—a piece of work which was of the greatest importance in determining the true position of this relic in the line of descent of Early Man, and disposed finally of the view that the jaw and the cranium were not related, but that the former belonged to some species of chimpanzee. Professor Elliot Smith has also dealt at much greater length with right-handedness and left-handedness, the erect posture, and the significance of skill in work and play. On these important topics his work is as stimulating as anything in those parts of the essays which remain unchanged, no light praise when it is remembered that it was in these discourses that he developed his theories of the significance of the development of stereoscopic vision and of the function of the neopallium in the evolution of the brain. In the new edition the references to the development of culture have been eliminated. This is perhaps not entirely an advantage. It was a conveniently accessible statement of fundamentals in Professor Elliot Smith's diffusionist position. There can, however, be no question that there is no better introduction to the theory of human evolution than this collection of essays.

E. N. Fallaize.

The Natural History of Ice and Snow. By A. E. H. Tutton, D.Sc., F.R.S. (Kegan Paul. 21*s.*).

If it be a maxim that a book should have a single purpose, then this book should be a failure, but Dr. Tutton has gone far towards disproving the maxim. The captious critic will say that it should have been two books or none, and without feeling captious we are inclined to agree with the first alternative, that there should have been two books. For when a crystallographer of the first rank undertakes the study of the structure and properties of ice we expect something worth while, and we are equally anxious to read the history of alpine climbing and descriptions of the Alps from a real lover of the mountains. But they do not always appeal to the same readers, nor do the two subjects form an easy material for welding; it has a patchy appearance and the cracks are rather plainly visible in spite of the author's skill.

Having thus criticized the plan of the book we can sit back and enjoy its separate parts with nothing carping to say. The portion devoted to the general properties of ice and snow is a skilful and useful résumé of our present knowledge, given with a minimum of technical language and leading up to the study of ice in the mass, its characteristics and mechanics of motion, but stopping with but very brief mention of that logical climax.

Indeed, away from his beloved Alps the author is apt to trip over his facts as in the credit given to reports of Antarctic bergs 800 feet high. They have been reported up to a height of 2,000 feet certainly, but never "observed" as more than 300 feet.

The part of the book dealing with the Alps and expeditions therein is entirely charming, even if it does stray from the title of the book. The enthusiasm of the author for the cult of climbing for climbing's sake will spread to most readers, even to those who, like the reviewer, have done their climbing for less spiritual reasons. The anecdotes, the 'tips,' the descriptions of scenery and the occasional excursions into the history of climbing make a very readable section which has all the utility of a guide-book without its vulgarity. One must also congratulate the author on his successful photography, though the small size of his blocks has not done it full justice.

F. DEBENHAM.

The Survival of the Unfittest. By CHARLES W. ARMSTRONG. (C. W. Daniel Co. 6*s*.).

The frequent quotations introduced by the author are sufficient to suggest that much in this book is not new. Its main theme has already been stressed in Major Leonard Darwin's "Need for Eugenic Reform," namely, the problem of counter-acting the less desirable elements in society. In what the author terms a "Fascinating Scheme," however, he proposes to overcome the objections of compulsory measures by establishing a settlement to which admittance would only be allowed to those of proved physical and moral fitness. Its maintenance would depend on the public-spiritedness of some millionaire or other endowment, as the success of the scheme requires members to confine their activities within this community. Debatable assumptions are made throughout the book, notably concerning the mechanism of heredity, but Mr. Armstrong admits that most of his opinions are frankly unconventional. Many readers will be interested, even if they find themselves unable to feel so sure of their conclusions on a subject which bristles with debatable points of very serious consequence.

Chemistry. By W. H. BARRETT, M.A., Assistant Master at Harrow School. (Oxford University Press. 5*s*.).

The Romance of Chemistry. By WILLIAM FOSTER, Ph.D., Professor of Chemistry in Princeton University. (George Allen & Unwin Ltd. 12*s*.).

If it is customary for those who achieve scientific distinction to acknowledge afterwards their debt to predecessors, the more ordinary student shares something of such pleasure when coming upon books written by those who have taught him. Indeed, the personal association may live in memory long after the instruction has been entirely forgotten, as it is by perhaps the majority of those who do not pursue a subject beyond some particular examination. The first of the books above appears to be based on lectures given to those preparing for the School Certificate, and it is interesting to the reviewer to read in print much matter that was taken down in lecture notes during a delightful introduction to chemistry under the author's guidance. The necessity for memorising the formulae of the elements and other fundamental data is greatly aided by clear tables, introduced, however, in the course of the argument and not as so often merely set out for parrot-like reproduction; while another point that cannot be emphasized too strongly for the beginner, the value of clear diagrams, is also borne out in this excellent book.

One of the main ideas behind the "general science" movement in schools, as Mr. Barrett says, is to bring science into closer relation with the facts of everyday life, and as is to be expected to a larger extent in an American text-book, Professor Foster devotes a great deal of space to industrial chemistry. The very broad scope that this method covers may tend to obscure the importance of fundamental principles, but in critizing this aspect it must be remembered that undoubtedly the American public is more technically-minded that the British. Where ten per cent. of the population drive their own cars this is a natural characteristic, and it has shown itself also in the phenomenal development of "radio" in America. The publication of Professor Foster's book in England fills a gap, in providing the reader with a vivid picture of chemistry in practice; as it is intended for the layman it would probably have been more attractive had the treatment of details necessary only to the student been omitted in favour of purely descriptive matter. The technicalities are, however, clearly introduced, as in the passages on catalysis which were contributed originally to *Discovery* (July, 1926). The two books make an ideal combination in the opinion of one who has studied under both authors.

J. A. B.

Frequency Curves and Correlation. By W. PALIN ELDERTON. Second Edition. (C. & E. Layton. 15*s*.).

This book arose originally out of an attempt to use Professor Pearson's system of frequency curves for the graduation of mortality tables, and additional matter has been included in the new edition. It assumes that the reader is familiar with the elements of statistical science, but demands no mathematical knowledge beyond that required for the first examination of the Institute of Actuaries or the Intermediate London B.Sc.; it is wisely pointed out, however, that as the subject is statistical and arithmetical, the methods can only be grasped by working out examples. Even the student who does not possess the mathematical equipment indicated should be able to use frequency curves and correlation reasonably with serious application, and to this end a helpful abridged reading is suggested in the appendix.

The author expresses the hope that his numerical examples may tend to show that actuarial statistics can be examined in the same way as those of biology, anthropology, or sociology, such work indicating a wider law than an actuary studying his own subject exclusively might be led to suspect.

Across Arctic America. By KNUD RASMUSSEN. (G. P. Putnam's Sons. 21*s*.).

This is the narrative of the main journey undertaken by the Fifth Thule Expedition, written by its leader, who was already well-known as a bold traveller in the Arctic and an enlightened student of Eskimo life and lore. By birth and blood, by training and sympathy, Knud Rasmussen was the man best fitted to carry out the ambitious programme of the expedition which was to visit and study all the tribes of the Eskimo from Greenland to Siberia. The journeys to this end involved some 20,000 miles of sledge travel, but of the methods of travel and living we hear singularly little, though all was done in the Eskimo manner. The main body of the expedition remained in the Baffin Land region carrying out general scientific exploration, but the scope of the book allows only the outlines of their work to be mentioned.

Besides the general account of the major incidents of the long journey we are given the summarized results, as far as

possible before the full working up of field notes, of the ethnographic study of the Eskimo. As stated very gracefully in the introduction, it is the Eskimo who is the hero of the book and its main theme is his history, culture, and spiritual life. The whole Eskimo race numbers apparently about 33,000 souls which, in the opinion of the author, is about the maximum number which can exist by hunting in those lands. The tribes are now very scattered and isolated, but it was not always so, and the author thinks that they broke off from a parent stock at least 1,500 years ago, a stock which was common to both Indian and Eskimo. The latter evolved a special culture of their own round the large lakes and rivers of Northern Canada whence they wandered as far east as Greenland.

It is of the exploration of a people rather than of land that we read here, and after reading it we cannot but agree with the author that these people are far less remote from us in outlook if not in culture than we had thought. The expedition had official sanction and royal patronage, and is but one more instance of the quiet but thoroughly efficient manner in which Denmark has accepted its responsibilities in the Arctic, thereby setting a high example to those other nations who have territorial possessions beyond the polar circle. F. D.

Local Geology. By A. MORLEY DAVIES, D.Sc., F.R.G.S., F.G.S. (Thos. Murby & Co. 1s.).

The amateur geologist when visiting a new part of England is often hard put to obtain information about its geology. This little pamphlet attempts to condense into its dozen pages the principal accounts of the geology of numerous areas in the British Isles. Taking the Geological Survey publications as a basis, the author enumerates the areas which have been treated in these issues, whilst he also gives the more suitable references in other literature. The papers of the Quarterly Journal of the Geological Society, of the Geologist's Association, together with its well-written "Geology in the Field," are drawn upon for information, together with a few local publications. There is a brief account of the types of map produced by the survey, and the present position of the current survey is indicated.

The book affords much information to the teacher, who will obviously want local examples to illustrate his lessons, and to the local enthusiast, but it is not intended for advanced students. J. E. H.

A Shorter Physical Geography. By EMMANUEL DE MARTONNE, Professor of Geography at the Sorbonne. Translated by E. D. LABORDE, B.A., F.R.G.S. (Christopher's. 7s. 6d.).

This book is the outcome of a meeting held early last year at the Royal Geographical Society, to consider ways and means of improving the geography textbooks available for use in the public schools. The author is regarded as the leading exponent in France of physical geography, and a more competent translator for the English edition could hardly have been chosen. As is pointed out in the preface, the work is strikingly different from English texts in the absence of over much geology and physics, so that the reader feels, in acquiring a knowledge of principles through the examination of typical regions, that he is dealing with geography and not with abstract science. It is significant that one part is entirely devoted to vegetable and animal life and distribution, yet the treatment is strictly geographical rather than botanical or zoological. Examples chosen from the British Isles and North America have been introduced so as to increase the usefulness of the book, which will certainly make a wide appeal also as signifying a new movement in the teaching of geography.

The Polar Regions. By R. N. RUDMOSE BROWN, D.Sc. (Methuen & Co. 12s. 6d.).

It was high time that a study of the polar regions should appear in a geographical series, for as the author points out many modern geographers are apt to ignore it altogether. If such people can be prevailed upon to read this volume they will soon realize that not only is it a truly geographical subject, but that the influence of the polar regions on "human" geography is so world-wide that they cannot afford to neglect their study. And certainly no better exponent of that study could have been selected. There are very few men who have experience of both polar regions, who have a sane perspective with regard to their value, and who at the same time are able to write clearly and vividly of geographical facts.

We have here then an excellent study of polar geography, dealt with under the several branches of that wide title. Roughly, the first half of the book deals with general features such as climate, ocean currents, ice, etc., and the latter half is devoted to more particular aspects such as the Eskimo, history, economic and political and trade routes. It must have been difficult to fall in with the exigencies of space, but one would have liked a fuller account of the Eskimo for instance, and something more about the evolution of polar travel. But the book as a whole presents very few points for criticism except possibly the maps in the text, which might with advantage have been increased in number and in detail. The folding maps at the end are fine examples of Bartholomew's work, but are of unnecessarily small scale so that there is little detail to be seen in the polar regions proper.

This book is bound to become the standard work on the subject, and it is to be hoped that in future editions the question of maps will be attended to, for although an author of a geographical textbook may usually expect his readers to consult an atlas, this is not the case when his subject is the polar regions, which in most atlases are but poorly represented.

F. D.

Maya and Mexican Art. By T. A. JOYCE. (*The Studio.* 10s. 6d.).

Anyone who has reviewed the vagaries of criticism of painting and sculpture during the last thirty or forty years will admit that in order to appreciate the merits of any given school or style, its conventions must be, or have become, familiar and they must be accepted. It is all the more necessary to keep this in mind when divergence in artistic style is an outcome of racial differences. The art with which Mr. Joyce deals in this volume of the *Studio's* series of "Great Periods in Art," is almost as far removed from our conventions as the wood sculpture of West Africa. Yet in both cases high artistic merit cannot be denied when once the limitations imposed upon the artist by conditions governing his technique, the conventions of form and composition, and the creative aim have been grasped. At first sight it may appear that the painting and sculpture of these early peoples of Central America are merely grotesque; that this great burst of artistic activity extending over centuries proved abortive and added nothing of real value to the aesthetic accomplishment of humanity.

Those to whom this field is new—and hitherto it has been to a great extent a preserve for specialists—cannot have a better guide than Mr. Joyce to correct such an erroneous impression. His wide knowledge of Maya and Mexican antiquities has enabled him to select the best examples of their sculpture, their frescoes and their painted pottery and manuscripts, to prove his contention that these artists had a mastery of line

and form which need not fear comparison with that of other great schools of art. Readers of Mr. Joyce's recent article in *Discovery* will remember that the rank growth of the jungle in Yucatan and Honduras has done much to disintegrate the buildings of the great period of the Early Maya Empire; but there is still abundant evidence that architecture was the field of their greatest achievement, even if only for the skill with which they solved the problems arising out of their failure to discover the true arch, and, further, turned that failure to artistic account by evolving the great entablatures which they covered with sculptures in relief. Mr. Joyce's lucid exposition of a subject which is complicated by the succession of race on race, owing to migration and conquest, is very fully illustrated by a large number of plates figuring examples of the arts and crafts. In view of the quality of material and workmanship, and the number of illustrations, the price of this book is remarkably low. E. N. F.

New Year's Day: The Story of the Calendar. By S. N. HOOKE.
Corn from Egypt: The Beginning of Agriculture. By MAURICE GOMPERTZ.
The Golden Age: The Story of Human Nature. By H. S. MASSINGHAM. (Gerald Howe. 2s. 6d. each).

These three little books belong to a series entitled "The Beginning of Things." The series is a popular exposition of the "diffusionist" theory of the common origin of civilization in Egypt as applied to the various departments of human activity. Mr. Hooke traces the history of the calendar from its beginning in ancient Egypt, and Mr. Gompertz describes the beginning of agriculture and certain features of the social and religious organization connected with it in the same country. Mr. Massingham's "Golden Age" differs in so far as it deals with another aspect of the same theory, which has once more brought forward the idea of a progressive deterioration of mankind under the influence of civilization. The authors deal with highly technical matters which are the subject of heated controversy, and yet difficult to treat otherwise than dogmatically in a popular exposition. It is surely premature to pronounce upon the origin of agriculture when experts—botanists, not archaeologists—are unable to agree as to the original habitat of wild wheat and barley, and while the relative priority of the earliest known examples of these grains and of cultivation in Egypt and Mesopotamia are still *sub judice*. Subject to this caveat the case is well put. The series is attractively got up, though the price may seem a little high for the amount of letterpress each volume contains.

Wonder Tales of Great Explorers. By ROBERT FINCH. (Aldine Publishing House. 1s 6d.).

Beginning with the story of how Vasco de Gama found the sea road to India, this book should please many besides the younger readers for whom it is written. Illustrated with unusually stimulating pen-and-ink sketches by Mr. Savile Lumley, the activities dealt with include in modern times the flight of Commander Byrd to the north pole, and the attempts to climb Mount Everest. The tales are told "just as fancy led," though in view of their primary appeal to children they would have been better arranged in historical order.

Books Received.

Fatalism or Freedom. By C. JUDSON HERRICK. (Kegan Paul. 2s. 6d.).
The Fellahin of Upper Egypt. By WINIFRED BLACKMAN. (George Harrap & Co. Ltd. 15s.).
Living Machinery. By A. V. HILL, M.A., Sc.D., F.R.S. (G. Bell & Son 7s. 6d.).
Footprints of Early Man. By DONALD A. MACKENZIE. (Blackie & Son. 5s.).
Ancient Civilizations. By DONALD A. MACKENZIE. (Blackie & Son. 12s. 6d.).
The Comparative Physiology of Internal Secretion. By L. T. HOGBEN. (Cambridge University Press. 10s. 6d.).
The Acoustics of Buildings. By A. H. DAVIS, D.Sc., and G. W. C. KAYE, M.A., D.Sc. (G. Bell & Sons Ltd. 15s.).
Archon, or the Future of Government. By HAMILTON FYFE. (Kegan Paul. 2s. 6d.).
Introduction to Physical Chemistry. By SIR JAMES WALKER, LL.D. (Macmillan & Co. 16s.).
Problems in Psychopathology. By T. W. MITCHELL, M.D. (Kegan Paul. 9s.)
We—Pilot and Plane. By CHARLES A. LINDBERGH. (G. P. Putnam's Sons. 7s. 6d.)
Creative Education. By H. FAIRFIELD OSBORN, LL.D., Sc.D. (C. Scribner's Sons. 10s. 6d.).
Newton's Interpolation Formulas. By DUNCAN C. FRASER, M.A., F.I.A. (C. & E. Layton. 8s. 6d.).
The Skate. By CHARLES W. CREASER, Ph.D. (A Laboratory Manual.) (The Macmillan Company. 4s. 6d.).
An Old Hebrew Text of St. Matthew's Gospel. Translated by HUGH J. SCHONFIELD. (T. & T. Clark, Edinburgh. 6s.).
Elements of Chemistry. By H. N. HOLMES and L. W. MATTERN. (The Macmillan Company. 7s. 6d.).
The Prospective Development of Peru as a Sheep Breeding and Wool-growing Country. By A. F. BARKER, M.Sc. (University of Leeds).
The Stone Age. By E. O. JAMES, Ph.D., F.S.A. (The Sheldon Press. 3s. 6d.).
The Story of the Roads. By C. H. HARTMANN, M.A., B.Litt. (Routledge & Sons Ltd. 7s. 6d.).
The Story of a Great Experiment. By W. MARGRIE. (Watts & Co. 2s. 6d.).
The Ant People. By DR. H. H. ENVERS. Translated by C. H. LEVY. (John Lane. 8s. 6d.).
An Outline of Philosophy. By BERTRAND RUSSELL, F.R.S. (George Allen & Unwin Ltd. 12s. 6d.).
Caledonia, or the Future of the Scots. By G. M. THOMSON. (Kegan Paul. 2s. 6d.).
Albyn, or Scotland and the Future. By C. M. GRIEVE. (Kegan Paul. 2s. 6d.).
Transactions of the Hull Geological Society. By THOS. SHEPPARD, M.Sc., F.G.S. (A. Brown & Sons Ltd. 5s.).
An Outline of Stellar Astronomy. By PETER DOIG, F.R.A.S. (Draughtsman Publishing Co. Ltd. 7s. 6d.).
The Oriental Institute of the University of Chicago Explorations in Hittite Asia Minor. By H. H. VON DER OSTEN. (University of Chicago Press. 5s.).
Simple Methods of Surveying from Air Photographs. By ST. M HOTINE, R.E. (H.M. Stationery Office. 3s. 6d.).
Evolution. By A. M. CROSFIELD. (Simpkin, Marshall. 1s.).
The Terror Dream. By G. H. GREEN, Ph.D., M.A., B.Sc. (Kegan Paul. 5s.).
Charles Dickens and other Victorians. By SIR ARTHUR QUILLER-COUCH. (Cambridge University Press. 5s.).
Studies in Literature. By SIR ARTHUR QUILLER-COUCH. (Cambridge University Press. 5s.).
Seaways and Sea Trade. By A. C. HARDY, M.A., B.Sc. (Routledge & Sons, Ltd. 15s.).
Sir Isaac Newton. By C. D. BROAD. (Oxford University Press. 2s.).
Spiritual Exercises and their Results. By AELFRIDA TILLYARD. (S.P.C.K. 7s. 6d.).
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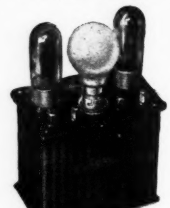

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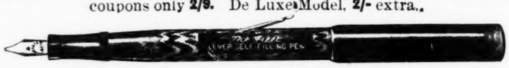

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